LIBRARY 23 1920 MICH.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2646, Vol. 105] THURSDAY, JULY 15, 1920 [Price One Shilling

Registered as a Newspaper at the General Post Office.]

[All Rights Reserved.

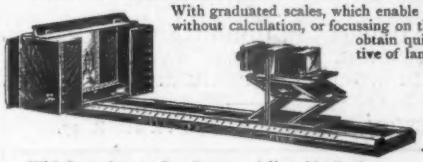
THE
SNOOK X-RAY
Interrupterless Machine

IS THE BEST APPARATUS
FOR RESEARCH WORK

No Inverse Current.
Completely under control.
Conditions can be absolutely reproduced from day to day.

Sole Makers for the United Kingdom—
NEWTON & WRIGHT, Ltd.
72 WIGMORE STREET, W. 1.
Wholesale and Export only.
Obtainable through any Scientific Instrument or Electrical House.

REYNOLDS & BRANSON, Ltd.
Chemical and Physical Apparatus Makers to His Majesty's Government (Home and Overseas Dominions), Laboratory Outfitters, &c.
BARR & STROUD LANTERN SLIDE APPARATUS.
With graduated scales, which enable an operator, without calculation, or focussing on the screen, to obtain quickly a negative of lantern size.



Descriptive Circular and Price on Application.

With Incandescent Gas Burners, Adjustable Book Holder, one Double Dark Slide and Le.s.

Chemical Glass, Porcelain, Nickel Ware, and Filter Papers.
Apparatus in Glass, Metal, or Wood made to customers' own Designs.
CATALOGUES POST FREE.
Enquiries for Technical Chemicals in quantity solicited.
14 COMMERCIAL STREET, LEEDS.

DUROGLASS LTD.
14 CROSS STREET, HATTON GARDEN, E.C.
Manufacturers of
Borosilicate Resistance Glassware.
Beakers. Flasks, Etc.
Soft Soda Tubing for Lamp Work.
General Chemical and Scientific Glassware.
Special Glass Apparatus Made to Order.
DUROGLASS WORKS, WALTHAMSTOW.
AGENTS:
BAIRD & TATLOCK (LONDON) LTD.
14 CROSS ST., HATTON GARDEN, E.C. 1.

New Patent Weather Forecaster
Enables the weather to be accurately determined for the next 12 hours.
Descriptive Leaflet sent on request.

NEGRETTI & ZAMBRA
38, HOLBORN VIADUCT, E.C.1.
5, LEADENHALL ST, E.C.3.
122, REGENT STREET, W.1.

ROYAL SCHOOL OF MINES.

FRECHEVILLE RESEARCH FELLOWSHIPS.

The Imperial College of Science and Technology, South Kensington, London, S.W.7, with which the Royal School of Mines is incorporated, is offering two RESEARCH FELLOWSHIPS of £300 a year each, tenable for one year and possibly renewable for a second year, to aid in carrying out any investigation or research connected with Mining, Mining Geology, Metallurgy, or the Technology of Oil, which in the opinion of the Selection Committee is of sufficient use or promise.

Applicants who may be Associates of the Royal School of Mines or others, and preferably men with some practical experience, should apply in writing to the SECRETARY of the College (from whom further particulars may be obtained) before September 1, 1920 giving the nature of the proposed investigation, qualifications for the work and references.

It is anticipated that the Committee will make the awards by the end of November, so that the Fellowships and work may begin on January 1, 1921. Holders will be expected to devote their whole time to the work which may be conducted at the Imperial College or in special circumstances elsewhere at the discretion of the Committee.

EAST LONDON COLLEGE

(UNIVERSITY OF LONDON),

MILE END ROAD, E.1.

PASS AND HONOURS COURSES IN THE FACULTIES OF ARTS, SCIENCE AND ENGINEERING.
FIRST YEAR MEDICAL COURSE.
POST GRADUATE AND RESEARCH WORK.

EVENING COURSES IN HONOURS, MATHEMATICS, M.A. FRENCH, M.A. & M.Sc. MATHEMATICS.
RESEARCH WORK IN EXPERIMENTAL SUBJECTS.

SESSION COMMENCES SEPTEMBER 27.

VACANCIES FOR LECTURERS IN BOTANY.

Applications are invited for vacant posts of LECTURERS in BOTANY at SCHOOLS OF AGRICULTURE in the UNION OF SOUTH AFRICA.

Candidates should be graduates in Science of recognised Universities, and have special knowledge in Botany.

Experience gained in Agricultural Botany is very desirable.

Duties include the instruction of students and the carrying out of experiment and investigation work.

Salary £400 per annum, rising, subject to satisfactory service, by annual increments of £30 per annum to £550 per annum.

Free furnished quarters are provided to single men, board being obtainable at the Schools at a charge of £50 per annum.

Free house (or an allowance in lieu thereof) is granted to a married man.

A temporary war bonus is also payable under present conditions.

Appointments will be considered at an advanced step in the scale if the successful applicant possesses exceptional qualifications or experience.

The appointments will be under contract for a period of three years, and may become permanent at the end of that time, provided the appointee makes himself conversant with both official languages.

Passage.—First Class Passage from Southampton to Capetown will be supplied to the appointee only, and First Class Fare over the South African Railways.

Applications (in duplicate), giving particulars of age, qualifications, and experience, accompanied by copies of testimonials (also in duplicate), should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, 32 Victoria Street, London, S.W. 1, not later than August 7, 1920.

WANDSWORTH TECHNICAL INSTITUTE.

The Governors invite applications for the post of PRINCIPAL of the Wandsworth Technical Institute.

The commencing salary will be £640, rising to £840.

Forms of application and further particulars can be obtained from the CHIEF CLERK, Wandsworth Technical Institute, High Street, Wandsworth, S.W.18.

LECTURERS are required for the EVENING CLASSES in:—

(*a*) Machine Construction, Applied Mechanics, and Practical Mathematics.

(*b*) Chemistry.

Salary 20*s.* per evening.

Forms of application and further particulars can be obtained from the CHIEF CLERK, Wandsworth Technical Institute, High Street, Wandsworth, S.W.18.

Applications must be received not later than July 19.

MINISTRY of AGRICULTURE, EGYPT.

The Ministry of Agriculture, Egypt, invites applications for the following appointments on its Agricultural Research Staff at Cairo:—

SENIOR ENTOMOLOGIST.—Candidates should have had experience in original research in Entomology. Initial pay £E600 plus bonus.

JUNIOR ENTOMOLOGIST.—Initial pay £E360 plus bonus.

SENIOR CHEMIST.—Candidates should have had experience in original research in agricultural chemistry. Initial pay £E600 plus bonus.

JUNIOR CHEMIST.—Initial pay, £E360 plus bonus.

Note.—The Egyptian Government bonus referred to consists of an increase of 20% to salaries and in addition a war gratuity of 60% on the salaries so improved, provided that the increase from the war gratuity does not exceed £E192 per annum and that the total increase from both sources of increment does not exceed £E300 per annum. The Pound Egyptian is worth about sixpence more than the Pound Sterling.

Candidates are expected to be in possession of Honours Degrees in Science, and in the case of the chemical appointments, preference will be given to Fellows or Associates of the Institute of Chemistry.

Applications, together with statements of qualifications and references, which will be received up to July 15, 1920, should be endorsed "Research Staff, Egyptian Ministry of Agriculture," and addressed to SIR ARTHUR WEBB, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, from whom all particulars regarding conditions of service, etc., can be obtained.

MINISTRY of AGRICULTURE, EGYPT.

The Ministry of Agriculture, Egypt, invite applications for the undermentioned appointments on its Agricultural Staff at Cairo. Candidates are expected to be in possession of Honours Degrees in Science.

CHIEF ECONOMIC BOTANIST.—Candidates should have had special experience in cotton breeding. Initial pay £800 plus bonus.

THREE JUNIOR BOTANISTS.—Initial pay £360 plus bonus.

Note.—The Egyptian Government bonus referred to consists of an increase of 20% to pensionable pay, and in addition a war gratuity of 60% on the salaries so improved, provided that the increase from the war gratuity does not exceed £192 per annum and that the total increase from both sources of increment does not exceed £300 per annum. The Pound Egyptian is worth about sixpence more than the Pound Sterling.

Applications, together with statements of qualifications and references, which will be received up to July 15, 1920, should be endorsed "Research Staff, Egyptian Ministry of Agriculture," and addressed to Sir ARTHUR WEBB, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, from whom all particulars regarding conditions of service, &c., can be obtained.

MINISTRY of AGRICULTURE, EGYPT.

The Ministry of Agriculture, Egypt, invites applications for the APPOINTMENT of an ARBORICULTURIST for the study and care of the street trees in Cairo. Candidates are expected to be in possession o a Degree in Science and must have had experience in tropical or sub-tropical climates.

The post carries an initial salary of £E480 per annum plus bonus, which consists of an increase of 20% to salary and in addition a war gratuity of 60% on the salary so improved, provided that the increase from the war gratuity does not exceed £E192 per annum, and that the total increase from both sources of increment does not exceed £E300 per annum. The Pound Egyptian is worth about sixpence more than the Pound Sterling.

Applications, together with statements of qualifications and references, which will be received up to August 15, 1920, should be endorsed "Arboriculturist, Egyptian Ministry of Agriculture," and addressed to Sir ARTHUR WEBB, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, from whom all particulars regarding conditions of service, etc., can be obtained.

FEDERATED MALAY STATES.

INSPECTOR OF FISHERIES.

The Ministry of Agriculture and Fisheries hereby gives notice that there is a vacancy for an INSPECTOR of FISHERIES in the FEDERATED MALAY STATES. The salary attached to the post is equivalent at the current rate of exchange to £840, rising by annual increments of £70. The exchange value of the dollar is fixed by the Government at 2*s.* 4*d.*, and no change in value is at present contemplated. In the event of a suitable candidate of considerable experience presenting himself, consideration will be given to the question of increasing the scale of pay accordingly. The period of engagement will be two, three, or four years. No permanent appointment can be offered at this stage. No age limit is imposed, but applicants must be trained Marine Biologists, and physically fit for service in the tropics.

Further particulars may be obtained from the FISHERIES SECRETARY, Ministry of Agriculture and Fisheries, 43 Parliament Street, London, S.W.1, to whom all applications, accompanied by not less than six testimonials, should be addressed, not later than August 3 next.

Ministry of Agriculture and Fisheries
(Fisheries Department),
43 Parliament Street, London, S.W. 1.
July, 1920.

THE UNIVERSITY OF LEEDS.

DEPARTMENT OF AGRICULTURE.

ADDITIONAL ASSISTANT LECTURER in AGRICULTURAL BOTANY is required, commencing salary £250 per annum. Further particulars may be had on application to the SECRETARY, The University, Leeds.

THURSDAY, JULY 15, 1920.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Medical Research.

"A TEACHING hospital will not be content solely with making the best possible provision for the treatment of injury and disease and for imparting knowledge; it will recognise as one of its most important functions also the increase of knowledge.

"The problems of disease presented by living patients are the most difficult and complex in the whole range of the physical and natural sciences. Much light can be shed on them by investigations conducted in physiological, chemical, pathological, pharmacological, and bacteriological laboratories, especially by experimentation on animals; but it is increasingly clear that the scientific study of many of these problems can be undertaken with the greatest advantage in well-equipped, special laboratories connected with the hospital clinics and in charge of investigators trained in chemical, physical, and biological methods, with convenient access to the material for study and in close touch with the clinicians.

"The familiar analytical and statistical study of cases of disease, based on simple clinical observations, and first extensively and fruitfully applied by the great French clinicians of the early part of the last century, has been of immense service to medicine, and will continue to be of service. A good clinical observation has precisely the same scientific value as a fact demonstrated in the laboratory, and, even if more difficult of interpretation, is often the safer guide for the action of the physician.

"It is, however, from the special clinical laboratories that we may reasonably hope for a more penetrating insight into the causes and nature of many diseases, an insight which perhaps may arm physicians with a saving power of prevention and treatment of some of the organic diseases of advancing life comparable to the inestimable gifts of bacteriological laboratories to the prevention and treatment of infectious diseases. We must welcome the establishment of such laboratories and the new directions which they are giving to medical research. When the purposes of such laboratories are made clear, their foundation and support should make an especially strong appeal to public and private philanthropy."

I have quoted these remarks made some thirteen years ago by the distinguished leader of American medicine, Prof. William H. Welch, of the Johns Hopkins University, because they express so precisely the motive and the object of the reforms to be effected at the University College Hospital Medical School with the help of the Rockefeller gift. Dr. Welch spoke not only with deep insight and eloquence, but also with the experience he had gained as the Father of the Johns Hopkins Hospital and its famous Medical School.

The aim of the reforms of medical education that were introduced at the Johns Hopkins University in 1893 was primarily to educate the medical student rather than merely to prepare him for examinations. In other words, every encouragement was given him to learn by personal observation and experiment and to rely upon his own judgment; and he was provided with every facility in the way of properly equipped laboratories and ample material to carry out this scheme of work. Above all, he was given the time, undisturbed by multitudes of didactic classes, in which to cultivate his powers of observation and acquire knowledge by his own efforts. In other words, the ideal was to make every student and member of the staff devote himself to original research and the advancement of knowledge. How fruitful such a method can become we know from the history of our schools of physiology. The influence of the great reforms introduced at University College by Prof. Sharpey eighty years ago was carried to Cambridge by Sir Michael Foster, to Oxford by Sir J. Burdon Sanderson, and to the Johns Hopkins University by Prof. Newell Martin; and the result of these practical methods of studying physiology has been to convert almost every department of that subject into an institute of research and a perennial source of new knowledge.

The contrast presented by departments of anatomy in the English-speaking world, before 1893 in America, but even now in this country, is profound. The remarkable activity of physiology has been one of the contributory causes; and the very circumstance that Sharpey, the reformer of physiological education, was primarily a professor of anatomy was one of the factors in sterilising the spirit of adventure in his own subject. This paradoxical result was due to the fact that as a professor of anatomy and physiology Sharpey was

at liberty to take from the former subject the more vital and interesting parts with which to render attractive his own particular hobby, practical physiology. When his disciples carried the new physiological gospel to Cambridge and Oxford (thence to English-speaking schools the world over), histology and embryology were regarded as part of the work of the department of physiology. This could not have happened if anatomy during the last half-century had had any men like Sharpey, Foster, Burdon Sanderson, or Gaskell to claim their rights and obtain the necessary laboratories and equipment for real research in anatomy. Instead of this, while most of the schools of anatomy fell into a condition of inertia, the gospel taught in the one active and dominant school was the complete repression of the scientific imagination and the crushing of all research that was not a mere record of facts. Franklin Mall was able to do what he did in America because he was not subject to this paralysing influence which was crippling British anatomy.

It is necessary clearly to appreciate these historical circumstances in order to understand the present contrast between the attitude towards research in anatomy in American and British schools. In many of our departments no attempt whatever is made to add to knowledge; in fact, in certain of them there is not merely apathy, but even active opposition to original investigation. But, for the historical reasons I have mentioned, there is no adequate provision in any anatomical department in this country of the means for carrying on research, even when the staff and students are anxious to do so. Those anatomists who, in spite of these obstacles, have been keen enough not to be altogether discouraged by them have in many cases done excellent research, but only to find, in not a few instances, that their zeal was regarded as an obstacle to their professional advancement.

Now that this unfortunate and not very creditable chapter in British anatomy is coming to a close, it is important to get a clear idea of the aims of such an Institute of Anatomy as the Rockefeller Foundation's gift will enable us to build up in London.

The chief purpose of the new building will be to provide ample room and equipment to permit the staff, graduate students, and even undergraduates, to investigate any aspect of the problems of man's structure and development. There will be dissecting-rooms and museums for the study of macroscopic structure, and laboratories and museums for the investigation of the manifold problems of anthropology and man's evolution; but there will also be laboratories for the practical study of embryology, histology, and neurology, both human and comparative, and every necessary kind of equipment for work in any of these subjects. Proper provision is to be made for research in radiography, with special reference to the light it throws upon the structure and functions of the living body and its development. In other words, the new institute is intended to provide accommodation and equipment for research in every aspect of anatomy and anthropology; and the close association which is to be established with the departments of physiology and vertebrate anatomy and with the hospital will help to widen the outlook of investigators in anatomy and give them a clearer vision. Special importance is attached to this integrating aspect of our scheme of work, because it is proposed to create in the institute a department for the experimental study of the factors that influence growth and development and the causation of anomalies of structure and pathological monstrosities. Research in experimental embryology has been one of the most fruitful and significant fields of work in American anatomy departments within recent years. It is difficult to exaggerate the importance of the work carried on at the Carnegie Institute of Embryology by such men as Drs. Streeter and Lewis and their collaborators, by Dr. Ross Harrison at Yale, and by Dr. Stockard at Cornell Medical School, to mention only a few out of many.

In addition to these fields of investigation, many of the schools of anatomy in America carry on experiments in genetics, not so much for the purpose of studying Mendelism as for correlating the results of breeding experiments with other branches of work in anatomy and experimental embryology.

To carry out a programme of this sort it is our aim to have a staff numerous enough to give every member at least half his time free from teaching to devote to research; for a teacher who is not actually engaged in investigation is merely a retailer of second-hand goods.

At a time when this serious attempt is being made to provide proper facilities for carrying on research in anatomy, it is particularly gratifying to know that the University of Cambridge has appointed to its chair of anatomy the most learned British exponent of the technique of

anatomy and embryology. By his extensive and exact knowledge of anatomy and his technical skill, no less than by his personality and sound judgment, Prof. J. T. Wilson will exert a great influence in the encouragement of anatomical research in this country. His appointment to Cambridge inspires the confidence that the dark days of British anatomy are numbered.

G. ELLIOT SMITH.

Intellectual Stock-taking.

(1) *Science and Theology: Their Common Aims and Methods.* By F. W. Westaway. Pp. xiii + 346. (London: Blackie and Son, Ltd., 1920.) Price 15*s.* net.

(2) *Recent Developments in European Thought.* Essays arranged and edited by F. S. Marvin. (The Unity Series.) Pp. 306. (London: Humphrey Milford; Oxford University Press, 1920.) Price 12*s.* 6*d.* net.

THERE seems to be a general disposition at the present time to take stock of the achievements of the human race in the generation which lived before the great cataclysm of the world-war. We feel, as mankind felt a hundred years ago after the great upheaval of the French Revolution and the succeeding Napoleonic struggle, that we are at the beginning of a new age. If we are to be effective in reconstructing and directing the new life of humanity, we must know the nature and extent of the forces in hand so far as they are under our control. The two books before us attempt this task in a very different manner. The first is the effort of a single worker to gather up and present, in a compact form and without bias, the definite results of recent scientific, religious, and philosophical research, and where they are conflicting or antithetical to state the case for each. The second book is the joint production of several workers, under the leadership of the author of "A Century of Hope," to express the characteristic features of the philosophy, religion, science, art, and history of the last half century, or more precisely of the period which begins with the Franco-German War of 1870 and ends with the outbreak of the great war in 1914.

(1) Mr. Westaway's work is primarily addressed to students of theology, and intended to aid them in finding a philosophic basis for their science. Before they can have this philosophic basis, however, they must, he thinks, master the main principles of mathematics, of science, and of scientific method. If, the student is told, he resorts to metaphysical arguments concerning the infinite before he has made himself acquainted with the nature of infinity in mathematics, he is violating the first principles of common sense. The same is true of physics, biology, and psychology. The student, we are afraid, will think it a hard saying, but then here is Mr. Westaway's epitome of the bases of all knowledge offered to him in tabloid form, compact and neat as in a medicine chest. Every theory that is held by anyone of authority in the sciences and philosophies, or which can be held, is set forth in abstract terms, and each summary of results is supported by a formidable list of books of reference. The theological student is left without excuse.

(2) A very different tone pervades the book edited by Mr. Marvin, for in this the personality of each of the twelve writers is given full expression. It makes the diversity more interesting than the unity. Perhaps the most telling contrast is between the positivistic tone of the general survey with which Mr. Marvin introduces the course, and the idealistic exuberance with which Miss Melian Stawell closes it. But surely the oddest contribution to the volume is Prof. Taylor's estimate of the philosophy of the last half century. It begins with a mystifying line of asterisks, and ends with a "note." The note is appended as an "apology" for omitting Bergson, or, rather, for refusing to regard that philosopher as other than a transient and spent force. The reason given is that his earliest work in its opening chapter contains "a couple of elementary blunders," and on these the whole of his philosophy is based. The note is certainly necessary, because the other essays in the volume might easily lead the reader to imagine that the period had been dominated by the philosophy of Bergson.

The meed of honour in philosophy is awarded by Prof. Taylor to Mr. Bertrand Russell, mainly on account of his joint work with Prof. Whitehead in "Mathematica Principia." He thus agrees with Mr. Westaway in holding the mathematical theory of infinity to be the basis on which philosophy must build. There can be no doubt that if the award is to be decided in the manner of the Greeks after the battle of Salamis, Mr. Russell must be acclaimed *facile princeps*, for there is no living philosopher in regard to whom such striking unanimity prevails. No one agrees with him, but everyone is anxious to set forth his reasons for disagreeing. Prof. Taylor is no exception. He looks in vain for any recognition by Mr. Russell of what he regards as the one vital and absolute necessity of philosophy, the attainment of knowledge about the soul and God. For this he refers us to the two eminent Italian

professors, Varisco and Aliotta, and omits any reference to their more celebrated contemporaries, Croce and Gentile. His prayer is "for a Neo-Thomist who is also a really qualified mathematician."

All the essays in the volume are interesting. Principal Jevons writes of religion from the point of view of folk-lore study; Mr. Gooch has given an admirable review of the history of historical research, the science which Croce names "storiografia"; while Prof. Bragg treats of "atomic theories," but is only able to indicate in a note the new interest aroused by the work of Einstein. Of this it is too early to take stock. H. W. C.

Petroleum Geology.

Geology of the Mid-Continent Oilfields. Kansas, Oklahoma, and North Texas. By Dr. T. O. Bosworth. Pp. xv+314. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1920.) Price 3 dollars.

IN this the latest contribution to the geology of the great Mid-Continent oilfields, Dr. Bosworth has contented himself with summarising the results of most of the recent work published by American geologists in the Bulletins of the United States Geological Survey, and in those of the Oklahoma and Texas Surveys in particular. His aim throughout has been to present the facts, leaving deductions to the intelligence of the reader, since, although he sets out with the intention of reviewing those facts, he does not succeed in attaining this end, for his final chapter, devoted to general conclusions, mainly deductive, occupies only a little more than five pages out of a total of 282 of text, and cannot be regarded as more than a somewhat hurried and non-committal postscript to the preceding sections of the book.

To any keen student of petroleum geology the announcement of a new publication dealing with one of the world's greatest oilfields is to be regarded with a certain degree of anticipation, partly with reference to possible new theories of oil accumulation and development, and partly (in this case) from a curious desire to see how far the teachings of the British geological school may be affirmed or modified by association in their own country with American oil technologists. This dual anticipation, however, is doomed to disappointment, because there is certainly nothing strikingly new in Dr. Bosworth's book, and one further perceives in the work a strong undercurrent of bias to prevalent American opinion.

It was to be hoped, for example, that new light would be thrown on the structure of the North and Central Texas fields, which are of such recent development and importance; but, beyond a brief description of the local "closed dome," "nose," and "terrace" structures originally described by Dorsey Hagar in his paper before the American Institute of Mining Engineers (1917), little information is forthcoming.

Another point on which more information is desirable is the possibility of the future development of the fields to the west. The general westward dip of the Palæozoic rocks tends to shift the oil horizons of the Pennsylvanian beds deeper and deeper in that direction, and further prospecting must inevitably lead to deeper drilling, assuming the structure to remain uniform. But it is by no means certain that such is the case, and on this point the author is unable to enlighten us. He suggests certain possibilities in regard to locating oil in the underlying Mississippian and in the overlying Permian "Red" beds; but in the former case the great depth to which borings must necessarily penetrate will tend to limit operations, whilst in the latter the oil occurrences are probably extremely localised, the conditions obtaining in the Healdton (Permian) field, which he quotes at some length, being the exception rather than the rule. It is only fair to add, however, that the short-sighted policy of many of the oil companies in prohibiting the publication of the results of detailed surveys prevents many workers from doing full justice to their research, and science, in consequence, must suffer accordingly.

It is interesting to note that in his conclusions the author regards the "vegetable" hypothesis as accounting for the origin of the hydrocarbons, and he further recognises White's laws of progressive devolatilisation as applicable to the Mid-Continent fields, an opinion which is in accordance with American views.

For the rest, the book certainly contains some useful features, the stratigraphy of the oilfields and the relations of oil accumulation to structure in most of the important fields being treated very concisely. The chemical side is by no means neglected, and the general characteristics of the Mid-Continental oil and natural gas, and the production of gasoline from that gas, are dealt with in some detail. Maps, plans, and photographs of the fields are included, together with a bibliography of the more important works relative to the area. The volume will probably make its strongest appeal to those who wish to gain a broad idea of the geology of the oilfields without having recourse to survey and other technical publications.

H. B. MILNER.

Fuel Problems.

Fuel Production and Utilization. By Dr. H. S. Taylor. (Industrial Chemistry Series.) Pp. xiv + 297. (London: Baillière, Tindall, and Cox, 1920.) Price 10*s.* 6*d.* net.

THIS volume is intended more especially as a post-graduate book which shall "supplement academic training with the broad facts of fuel production and utilisation." The main sources from which the author has drawn his material are the valuable bulletins issued by the United States Geological Survey and the Bureau of Mines, supplemented by other American and Canadian sources of information. Everyone familiar with fuel problems realises the great value of these publications, and although many of the author's quotations from these and his other sources are lengthy, his judicious selection of material has enabled him to compile a volume which cannot fail to be of value to a much wider circle than post-graduate students.

A great change in the fuel problem has followed from the enormous rise in the price of coal, and it is difficult to see what the far-reaching ultimate effect will be. Certain it is that man will be driven to consider the utilisation of much material which has hitherto received but little attention, and to give closer attention to using the last heat unit possible in every ton of coal. While coal was cheap economists preached to deaf ears; economic necessity will produce effects which years of preaching failed to accomplish. Dr. Taylor's book should go a long way to help those who are prepared to take the serious view which the situation demands of these problems, and it is of value not only as recording what has been done in the near past, but also as indicating possibilities in fuel utilisation in many directions.

One of the features of the book is the broad outlook of the author on many of the problems which, whilst at present of very minor importance, bear evidence of becoming of considerable practical importance with the great alteration in conditions in the fuel situation. The utilisation of the minor fuels—peat wood, coke for industrial purposes, and pulverised coal—together with the many problems associated with the low-temperature distillation schemes, are more adequately dealt with by Dr. Taylor than by most writers of general books on fuel, the considerable space devoted to these problems being amply justified by their potential importance.

From the scientific point of view the "synthetic" fuels are of considerable interest. In the future some may become of great importance. The merits of alcohol as a fuel are now very widely recognised, and the author gives an excellent account of this question. Closely connected—indeed, part of the problem—is acetylene as fuel, either directly, for small motor vehicles have been driven by this gas, or more specifically as a possible source of alcohol. Several processes for the conversion are referred to, the steps usually involving the formation of aldehyde by absorption in acids, generally in the presence of mercury salts, and the conversion of the aldehyde into alcohol by reduction by Sabatier's method with hydrogen in the presence of nickel as a catalyst.

Of a similar character is the production of hexahydrobenzene (hexamethylene) by the hydrogenation of benzene. The author points out the advantages of such a fuel of constant composition and properties, but he does not refer to the one great disadvantage of this compound, namely, its high freezing point (6·4° C.). He refers to it as suitable for aeroplanes, but this high freezing point obviously entails serious difficulties. In admixture the claim for homogeneous composition is gone, and even alone it is difficult to see what advantages it possesses over benzene, which has approximately the same freezing point, or even over commercial "benzol," which freezes below 0° C. and has no greatly varying degree of volatility.

J. S. S. B.

Hurter and Driffield.

A Memorial Volume containing an Account of the Photographic Researches of Ferdinand Hurter and Vero C. Driffield: Being a Reprint of their Published Papers, together with a History of their Early Work and a Bibliography of Later Work on the Same Subject. Edited by W. B. Ferguson. Pp. xii + 374. (London: The Royal Photographic Society of Great Britain, n.d.) Price 25*s.*

DR. HURTER died twenty-two years ago, and Mr. Driffield afterwards did little or nothing more in connection with their joint labours than complete and publish the work that was almost finished. It is possible now, therefore, to regard their work as a whole, and to see something of the relationship that it bears to the general progress of photography from the scientific point of view.

Hurter and Driffield did two very considerable things. They devised the method of drawing what they called, and what is now universally known as, the "characteristic curve" of a developable sensitive surface. This may at first appear a very easy thing to do, but it is often the things that are easy to do which are the most difficult to get at and of

the greatest fundamental importance. With the curve are, of course, included the units that it involves and the facts that it represents. As to its advantages, it is enough to say that it was at once adopted wherever photography was regarded as a science, and no better method of expression has since been suggested.

Their second notable achievement was that they promulgated certain conclusions to which they had come with an energy and assurance that stand unique in connection with this, if not with all scientific subjects. Their statements in their communication of 1890 with regard to some of the opinions and experiences of others as interested in the subject as they were, were put in such vigorous language that they amounted to challenges. Of course, this led to discussion and to further work; and discussion breeds discussion, and work breeds work. Dr. Hurter and Mr. Driffield either separately or jointly were always ready to take any pains, by reading papers, often travelling long distances to do so, by writing articles, or by personal correspondence, to make clear and to uphold their views. They thus administered a powerful stimulant to scientific photography.

It is of very secondary interest what these views were, because the whole subject has received since then more attention than any two persons could possibly devote to it; and, indeed, Hurter and Driffield themselves, in their last important communication on "The Latent Image and its Development," demonstrate by further experiments the necessity of largely, if not radically, modifying the statements to which so much exception had been taken.

It must not be supposed that Hurter and Driffield set out with the intention of doing the two things that we have endeavoured to describe. To quote their own words: "Our object was to discover a method of speed determination, and it was not, as the [photographic] public seemed to infer, to deal finally and exhaustively with the subject of development. This subject was purely incidental. . . ." As everyone knows, they did devise a method for the estimation of sensitiveness, and, as might be expected from such capable men, a method wholly different from any other, but, like all methods, it has its advantages and its disadvantages. The sensitiveness of a plate is not definite except under definite conditions, and in practical work the conditions are not uniform.

It is but a short step from the courteous and ever kindly Hurter and Driffield to the memorial volume before us, because Mr. Ferguson has done his work well and with full sympathy. The volume begins with Mr. Ferguson's recent lecture on their early work, which is followed by a review of Dr. Hurter's mathematical work by Dr. H. Stanley Allen, and by the patent specifications of the early actinometer and the actinograph. Then come reprints of all their important communications to societies and journals. Mr. Ferguson has certainly not erred in the direction of making too exclusive a selection, though he tells us that there are many other publications of theirs, chiefly polemical letters to the photographic Press, which, if reproduced, would have filled two more volumes. After this there are a bibliography of 717 items, extending from 1881 (Hurter's actinometer patent) and 1888 (the actinograph patent) to 1918, and name and subject indexes. If there should exist anyone interested in scientific photography who is so saturated with the work of Hurter and Driffield that the reprints do not appeal to him, even he cannot fail to find the bibliography and indexes of considerable use. C. J.

Our Bookshelf.

Bygone Beliefs: Being a Series of Excursions in the Byways of Thought. By H. Stanley Redgrove. Pp. xvi+205+32 plates. (London: William Rider and Son, Ltd., 1920.) Price 10*s.* 6*d.* net.

THIS series of fragmentary discussions extends over a vast area: Pythagoras and his philosophy, medicine and magic, bird superstitions, powder of sympathy, talismans, ceremonial magic, architectural symbolism, the Philosopher's Stone, the phallic element in alchemical doctrine, Roger Bacon, and the Cambridge Platonists. It is inevitable that a discussion of such varied subjects in a limited space is not likely to be fruitful, nor will the author's interpretations command universal acceptance. Thus we are told that "the alchemists regarded the Philosopher's Stone and the transmutation of the base metals into gold as the consummation of the proof of the doctrines of mystical theology as applied to chemical phenomena," though some were influenced by more material objects. The premises from which they started were "the truth of mystical philosophy, which asserts that the objects of Nature are symbols of spiritual verities. There is, I think, abundant evidence to show that alchemy was a more or less deliberate attempt to apply, according to the principles of analogy, the doctrines of religious mysticism to chemical and physical phenomena." Of course, it is generally admitted that the idea of transmutation had a philosophical basis such as it was, and that alchemy to some extent unified and focussed chemical effort, but it was, to use Liebig's words, "never at any time anything different from chemistry."

While it is difficult to accept the author's transcendental interpretations of these and kindred phenomena, he has collected much curious learning, for which he supplies adequate references,

and he gives us a number of curious illustrations, one of which, however, may judiciously have been omitted in a book which claims to be popular.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By Prof. J. A. Fleming. Third edition, revised and extended. Pp. xiv+370. (London: Constable and Co., Ltd., 1919.) Price 21*s.* net.

IN preparing a new edition of his well-known study of the propagation of telegraph and telephone currents, Prof. Fleming has taken the opportunity of bringing it in line with both the latest theoretical and the latest practical work in this field. The subject presents a very fine example of mathematical investigation leading to results of far-reaching practical utility, and the author conducts his reader along a logically continuous path from the point where he introduces him in the first chapter to hyperbolic functions of complex angles, to the page near the end where he pauses to show him a picture of a telephone cable with loading coils being laid across the Channel. Telegraph and telephone engineers owe a great debt of gratitude to Prof. Fleming for the way he has, at first in his lectures and then in the volume now before us, brought together so much valuable work in this complicated subject, to which he himself has been no mean contributor. Perhaps the most valuable feature of the treatment is the way in which he has simplified, so far as possible, the mathematical results of the original investigators, while at the same time facilitating the building of the bridge from the other end by providing the material to extend the student's mathematical resources in the required direction.

Half-past Twelve: Dinner Hour Studies for the Odd Half-Hours. By George W. Gough. Pp. vi+77. (London: Sells, Ltd., n.d.) Price 1*s.*

THERE is abundant evidence that much of the present-day industrial unrest arises from the ready acceptance of fallacious economic ideas by many of those engaged in industry. The need for sound teaching in the first principles of economics of a character within the ready understanding of working men and women, and of all who help to form public opinion, is acute, and Mr. Gough has rendered a valuable service in helping to satisfy this need.

This inexpensive little book is an attempt to correct wrong economic ideas and a limited perspective by providing a series of talks on familiar economic topics such as production, capital, profits, wages, the mechanism of exchange, and the principles of taxation. The author deals with these in a brief but extremely lucid manner, and his conclusions, while significantly orthodox, are arrived at without bias or prejudice. His illustrations are most apt, and will effectively secure the interest of his readers. It is to be hoped that this publication will be widely read not only by industrial workers and students, but also by the public generally. A. P. M. F.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Separation of the Isotopes of Chlorine.

PROF. SODDY (June 24) and Mr. Core (July 8) have in their comments on my letter in NATURE of June 17 raised several points of interest. The former asks that all the assumptions from which the equation

$$[Cl'_2][Cl_2]=[ClCl']^2$$

was deduced may be given. The assumptions are:

(1) The differences between the vapour pressures of the three varieties of chlorine are negligibly small.

(2) The vapours are almost perfect gases.

(3) The three varieties of gaseous chlorine are separable by semi-permeable membranes or other means, or the equivalent assumption that the thermodynamic potential of a mixture of the three varieties is the sum of the thermodynamic potentials of the constituents.

(4) The work required to convert reversibly 1 mol. of solid Cl'_2 and 1 mol. of solid Cl_2 into 2 mols. of solid $ClCl'$ is negligible.

The three last assumptions lead us to the formula

$$0=\log_e K+\log_e \frac{\{ClCl'\}^2}{\{Cl_2\}\{Cl'_2\}}$$

where the bracket { } indicates concentration of saturated vapour. Whence with the aid of assumption (1) we deduce that $K=1$.

Assumption (4) follows from Nernst's heat theorem if it be postulated that the energy of the change considered is almost zero. It would appear, therefore, that if isotopes are inseparable by processes similar to that described in my first letter, one of the assumptions made is not valid.

Prof. Soddy asks whether there is any step in my argument to prevent its being applied to prove the possibility of the separation of arbitrarily selected atoms from a group of completely identical molecules by chemical means; for, if there is not, then it follows, as a *reductio ad absurdum*, that the equilibrium equation

$$[Cl'_2][Cl_2]=[ClCl']^2$$

is wrong, and it is unnecessary to test its validity by experiment. Concerning this query I am in doubt whether it would be generally admitted that assumption (3) could be made in such a case as that contemplated by Prof. Soddy, and therefore I think it is desirable that the question of the validity of the equation should be submitted to the test of experiment—so far as it is possible to do this.

Mr. Core assumes that the isotopes of chlorine are inseparable by chemical means, but does not agree with my conclusion that if such is the case Nernst's heat theorem will be difficult to defend. He admits that at finite temperatures the difference in entropies of the solid reactants and resultants is $R \log_e 4$, but he argues that it may become zero at zero temperature owing to the effects of the differences in properties of the three solids being more pronounced at exceedingly low temperatures. But even if it be admitted that in the case of chlorine the difference between the entropies of the reactants and resultants can be nothing at zero temperature and $R \log_e 4$ at finite temperatures, it has still to be explained how the same rise in the difference of entropies from zero to the constant value $R \log_e 4$ could occur for a change of the same type in the case

of another element which exists in the form of two isotopes differing much less in their atomic weights than those of chlorine. Furthermore, if we put $A=f(t)$, and if $f(t)$ can be expanded in the analytical series,

$$f(o)+t.f'(o)+\frac{t^2}{\lfloor 2}.f''(o)+, \text{ etc.},$$

and $f'(o)$ is zero as Nernst assumes, then it must be explained how the series

$$f(o)+\frac{t^2}{\lfloor 2}f''(o)+, \text{ etc.},$$

can become almost equal to $t.R\log_e 4$ between wide limits of temperature.

In fact, if the isotopes are inseparable by chemical means, I think that the most natural conclusion to draw is that the difference in the entropies of the reactants and resultants of a chemical change taking place at zero temperature is a finite quantity which depends on the type of the change, and also, of course, on the number of molecules transformed.

Jesus College, Oxford. D. L. CHAPMAN.

Anti-Gas Fans.

OWING to my absence from home I did not see Prof. Allmand's letter in NATURE of June 10 on my indictment of the War Office until too late to reply to it last week, but I hope you will now allow me to put before your readers a few of the points he has missed.

First, may I repeat that I had no personal interest in the number of fans sent out, since I neither asked for nor would accept payment or reward *of any kind or description* for their use during the war. I attributed the suffering and loss of life, which I deplore and Prof. Allmand denies, even more to the lack of training, and consequent ignorance of what the fans could do, than to their scarcity.

From this letter I gather that his own knowledge concerning them is of the slightest. He seems never to have heard of the clearing of trenches with them, the purpose to which they were principally put; but he allows that they were "found useful" for clearing shelters and dug-outs that would otherwise have remained dangerous for "hours, or even days," after a gas attack. We have only to picture our men, after hours of hard fighting, perhaps wounded or already gassed, compelled to remain in the open, whatever the weather, with the remains of gas still there, to realise the vital importance of clearing every space, dug-out, and shelter the moment it was possible. Yet for a whole year (May, 1915, to May, 1916) the use of the fans with which it could always have been done in a few minutes was held up by the wilful obstruction of War Office officials. It must be remembered, too, that at the beginning of that year the respirators were still quite crude and untrustworthy, and that even by the end of it they were very far from perfect. Is it too much to say, then, that "much suffering and loss of life could have been avoided" had the fans been accepted, and the troops properly trained to use them, nine months earlier, as they could so well have been? On this point Prof. Allmand is silent.

He says that, later, fires were found to be as efficacious as, and less fatiguing than, fans. They were not as efficacious, but they were certainly less fatiguing, as I have said, when the materials were ready to hand; and it was perfectly right to use them when practicable. But each time a space was cleared by fire, fresh *dry* wood and paper were required. Now it is common knowledge that there were wide areas which, over long periods, were so wet that dry wood for even one clearing would have been hard to find, let alone many. Is it an exaggeration to say that "much suffering and loss of life could have been avoided" if those responsible had remembered this, and had provided not only plenty of fans for every area, but also men trained to use them? On this point also Prof. Allmand is silent.

"Working an Ayrton fan, *even in the most approved fashion*"—my italics—he says, ". . . is a tiring task." Prof. Allmand will, I am sure, be surprised to learn that there are at least three approved fashions, and that the efficiency of the fans depends almost more on the ability of the officer in charge to choose the right method for the particular space, and to place and move his men properly, than on the skill of the wielders; moreover, the approved methods are not less fatiguing than the wrong ones, only infinitely more efficient. This ignorance on the part of an authority on anti-gas methods is not unique; it is typical. Let me show how it arises.

As soon as the fans were accepted I warned the War Office that, if they were to be of any value, officers and men alike *must* have two or three days' practical training in their use; and, at the request of the Commander-in-Chief, my assistant went to France to show how the training should be carried out. At first, after he left, it may have been fairly well done; but in time those who had seen for themselves what the fans could do died or became scattered; and after that the training degenerated at best into an hour or two of exercise in the stroke for trench-clearing, and at worst into the mere exhibition and naming of a fan, while numbers of men never even saw one at all. Major Gillespie, D.S.O., who practically saved his battery by means of the fans, when a howitzer battery within a hundred yards of it was wiped out, wrote to the *Times* of May 4: "Even after the introduction of the fans in limited quantities, I never met an officer or man who had been properly instructed in their use." This ignorance, for which the War Office is responsible, extended from the highest to the lowest officials in the Anti-Gas Service. The only men who did not share it were those officers who were clever enough and interested enough to make out for themselves what could be done with the fans. Small wonder, then, that most officers regarded them simply as nuisances, and that some of the men treated them as fuel.

This same ignorance and want of imagination led to the idea that the fans were useless for dealing with mustard gas. In describing the saving of his battery Major Gillespie wrote: "The gas hung about for days afterwards, but by judicious flapping at frequent intervals we kept our quarters fairly free from it." This is the evidence of a "fighting soldier." It is odd that those other fighting soldiers quoted by Prof. Allmand should not have thought of this very simple way of ridding themselves of a vapour that came off slowly and took some time to reach a dangerous concentration.

Finally, is not Prof. Allmand in his last sentence confusing scientific methods with the methods of some scientific men? In directing attention to the dire effects of the unscientific methods of the War Office in connection with anti-gas fans, I was adding my quota to the efforts of those who are trying to "ensure the application of scientific methods to military problems." The fact that it was scientific men who were responsible for those unscientific methods is surely no reason for condoning them, but rather for censuring them the more severely.

HERTHA AYRTON.

41 Norfolk Square, W.2, June 22.

AT the risk of the accusation of shirking inquiry, I repeat that I have no intention of entering into a

controversy with Mrs. Ayrton. It will suffice to say that she is writing of things of which her knowledge is, naturally, second-hand, besides being clearly very inadequate. This is apparent in at least eight separate points in her letter, of which I will only refer to her mention of the successful use of the fans in what must obviously have been a *very* exceptional type of "mustard-gas" bombardment. I assure Mrs. Ayrton that she is mistaken if she imagines that she has in this matter any considerable body of support amongst those who knew the facts, from whatever point of view. I hope, in conclusion, that nothing I wrote has led Mrs. Ayrton to suppose that I regard her advocacy of her fans to be influenced by questions of "payment or reward." Nothing was further from my mind.

A. J. ALLMAND.

King's College, W.C.2, June 30.

PROF. ALLMAND, having read neither the specific charges I have made against the War Office nor the evidence, principally from official documents, with which I have sustained them, attempts to counter them with statements unsupported by evidence of any kind. He finds me ignorant, for instance, on eight points, of which the only one he names is obviously no matter either of my knowledge or ignorance, since it refers simply to a quotation from the letter of a very able and gallant "fighting soldier." Had he read the article he criticises he would have seen the whole quotation.

I am ready to sustain those charges, and to produce the evidence before any proper tribunal. I repeat them.

I accuse the War Office of having caused great loss of life and much avoidable suffering by:

(1) Having refused for a whole year to make use of anti-gas fans, which they were yet compelled finally to adopt owing to their proved efficacy.

(2) Never having set up an efficient organisation for training officers and men in their use, although I had warned them that this was indispensable.

(3) Having thus deprived the troops of the knowledge requisite for understanding what could be done with the fans, and having thereby induced the idea that they were useless.

(4) Having trusted entirely to fires for clearing dug-outs of gas, regardless of the fact that in many places dry wood and paper were often unobtainable.

(5) Ranking sandbags and ground-sheets as of equal efficacy with fans for clearing gas.

(6) Sending out an inadequate supply.

The scientific men implicated in these grave charges have not even made the plain statement with regard to them that the Editor of NATURE considered so desirable, much less produced any evidence in refutation of them.

HERTHA AYRTON.

July 11.

THE continuance of this correspondence in our columns would not, we think, serve any useful purpose. In a note in NATURE of May 13 it was pointed out that Mrs. Ayrton's indictment of the War Office was "not against the military element, but rather against the experts who were associated with the Gas Service." It is easy to understand the reluctance of these officers to express their views upon anti-gas fans, even if they were free to do so; and though Mrs. Ayrton is anxious to have all the facts judged by a tribunal appointed for that purpose, we must confess that the likelihood of a scientific body constituting such a tribunal is very remote. The inquiry is one that the Conjoint Board of Scientific Societies could take up appropriately, but no satisfactory conclusion could be reached without examining a number of witnesses, and the resources and powers of the Board are scarcely sufficient for such action. The only practicable course, therefore, would seem to be for the War Office to appoint a Committee to investigate Mrs. Ayrton's charges, and in the interests of scientific truth and efficiency we hope this will be done.—ED. NATURE.

The Stretching of Rubber in Free Balloons.

IN NATURE of June 10, p. 454, in connection with the attainment of high levels of the atmosphere by sounding- or pilot-balloons, Mr. W. H. Dines considers that such balloons would burst before reaching great heights, as the rubber of which these balloons are made would be stretched eightfold linearly, and he remarks that he does not think that any rubber will stand this treatment.

Properly vulcanised soft rubber will, however, stretch to more than ten times its original length if in the form of a ring-shaped test-piece. Moreover, the load increases more rapidly than the elongation at the later stages. The remarkable tensile properties of soft rubber are not always sufficiently recognised. The breaking strain of a properly vulcanised sample should be not less than 1500 grams per sq. mm. cross-sectional area of the original test-piece. Allowing for the stretching, which would reduce the cross-sectional area to one-tenth, the breaking strain would be 15,000 grams per sq. mm. cross-sectional area of the sample when fully elongated, or nearly 10 tons per sq. in. It would not, however, be safe to rely on these figures, as the rubber of the balloon would tear at the neck where it is tied together before the bursting pressure was reached. Mr. Dines has also failed to take into consideration the fact that part of the hydrogen would be lost by diffusion during the ascent of the balloon, which would reduce the pressure of the contained gas.

HENRY P. STEVENS.

15 Borough High Street, London Bridge, S.E.1, June 29.

WITH reference to Mr. Stevens's interesting statements about the stretching of rubber, I think he has overlooked the fact that in a balloon the rubber is stretched simultaneously in both directions, whereas he refers apparently to one direction only.

I have cut a strip half an inch wide from a balloon used at Benson; it stretched sevenfold before breaking, but when extended sixfold its width was reduced from 0·50 in. to 0·22 in., instead of being extended to 3·00 in., as would be the case in actual use. Its unstretched thickness was 0·013 in., its thickness at breaking greater than 0·004 in., but when extended sixfold each way its thickness would only be 0·00036 in.

The loss of hydrogen by diffusion or leakage is equivalent to not giving the balloon so large a free lift at starting, and would alone increase the height, but in practice it sometimes leads to the bursting height not being reached at all because the free lift has vanished before that point is reached. It has been found that within fairly wide limits the maximum height is only slightly dependent on the free lift at starting. But diffusion of the hydrogen outwards is accompanied by diffusion of air inwards, and this increases the specific gravity of the gas and lessens the height.

I did not mention the effect of the tension of the rubber on the pressure, and therefore on the specific gravity, of the enclosed gas. Taking Mr. Stevens's figure of a breaking strain of 15,000 grams per sq. mm. of unstretched section, this will raise the internal pressure by quite an appreciable amount, and thereby reduce the height at which the balloon bursts.

Benson. W. H. DINES.

Note on the Habits of the Tachinid Fly, *Sphexapata* (*Miltogramma*) *conica*.

FABRE has given a graphic account of the patient watch of this parasitic cuckoo-fly at the mouth of the burrow of a species of Bembex, and of its cunning in seizing the moment when the "wasp" is halt within the burrow to deposit its tiny egg, pregnant with disaster to the Bembex offspring, upon the body of the insect victim intended for the larder-nursery wherein the mother Bembex's hopes are laid. He does not, however, appear to have witnessed in the tragedy a phase that recently came under my notice, and that is possibly restricted to, or perhaps only easily observed, in cases where the foster-host carries its prey along the surface of the ground, or at best flies only just clear of the ground.

On the afternoon of June 22, when on one of the heaths in this neighbourhood, I caught sight of a black Fossor, *Tachytes unicolor*, carrying a paralysed grasshopper. I followed, hoping to secure a photograph of its operations at the burrow. Soon I discovered that I was not the only follower, for at a distance of about four inches there followed a small Tachinid fly, which Mr. J. E. Collin has kindly identified as *Sphexapata conica*. The fly followed the "wasp" with the utmost accuracy, maintaining its distance with a precision that suggested a rigid connection between the two insects; if the "wasp" flew, the fly flew; if the "wasp" crawled, or indeed took but a single step, the fly did exactly the same; and always keeping distance accurately. For more than fourteen yards—and there may have been many more before I came upon the scene—did the fly thus follow in the wake of the "wasp," until at length the burrow was reached. The "wasp" at once entered, leaving the grasshopper lying, belly upwards, at the burrow's mouth; but before the owner was out of sight the fly darted upon the grasshopper, without a moment's delay deposited an egg on its thorax, and flew off—into my net.

Fabre says nothing as to the distance at which the fly stations itself when keeping watch at the mouth of the burrow, nor of the interval between each individual when several "in a geometrical line" are awaiting the critical moment; but the constancy with which the fly kept station in the journey across the heath, and the precision with which every movement of the "wasp" was copied, suggested that at that particular distance a clearer visual image was secured than at any other. Be this as it may, the fact is worth consideration in discussing insect vision.

To this note I may appropriately add an observation made last year while watching an *Ammophila sabulosa* filling in its completely stocked burrow. On a stone close by there sat a small fly absolutely motionless, and apparently intently watching the proceedings. As soon as Ammophila had finished its work and flown off, the fly leapt from its perch, and at once began to scratch away the sand and small stones in an endeavour to get at the larvæ in the subterranean larder. Fortunately, Ammophila had packed its burrow too well, and the fly flew off defeated. This fly closely resembled *Sphexapata conica*, but may have been an allied species.

Sharp ("Camb. Nat. Hist.," vol. vii., p. 509) mentions the fact that Miltogramma follows Hymenoptera carrying prey.

OSWALD H. LATTER.

Charterhouse, Godalming, July 4.

Temperature Variations at 10,000 ft.

A SERIES of 500 aeroplane observations in North-East France in 1918–19 throws some light on the problem of temperature variations in the upper air. The correlation coefficient between pressure and temperature at 10,000 ft., taking all the observations together, is 0·73. If the seasonal variations are allowed for by taking the deviations from Mr. W. H. Dines's smoothed monthly means, the coefficient is 0·69. The former value is higher, as the annual variations of temperature and pressure in the upper air are in the same phase. Both figures are rather lower than the value 0·77 for 3 km. obtained by Mr. Dines from balloon soundings, the observations being grouped in three-monthly periods. The value 0·69 implies that a proportion $\sqrt{1-0{\cdot}69^2}$, or 72 per cent., of the standard deviation is still unaccounted for. The partial correlation coefficient between the temperature and the southerly component of the wind velocity at 10,000 ft. (allowing for the pressure) is 0·44, so that the southerly component accounts for 10 per cent. of the temperature variations which are independent of the pressure, or 7 per cent. of the total variations. The effect of the west component of the wind velocity is practically negligible at all seasons.

There are strong grounds for believing that a large proportion of the temperature variations depends upon whether the air supply was drawn originally from the polar basin or the equatorial belt. This view is supported by the humidity observations which were made at the same time as those for temperature. For reasons set out in a paper which I hope to publish, the original source of the air supply is not very closely related to the wind velocity at the place of observation, both polar and equatorial currents frequently following curved paths. This factor of air supply operates in a very irregular manner, with the result that the correlation coefficients vary greatly from month to month. The coefficient connecting pressure and temperature at 10,000 ft. for the period January–February, 1919, based on fifty observations, is as low as 0·09. In the winter especially there are large fluctuations of the upper-air temperature, the changes occasionally exceeding 30° F. within forty-eight hours both at 10,000 ft. and 14,000 ft.

Mr. Dines gives a value 0·86 to the pressure-temperature correlation coefficient from 5 km. to 8 km., but this accounts for only half the temperature variations.

C. K. M. DOUGLAS.

Meteorological Office, Air Ministry, W.C.2, July 8.

The Brent Valley Bird Sanctuary.

SUNDAY next, July 18, is the two hundredth anniversary of the birth of Gilbert White of Selborne, who did more than any other of our countrymen to create an interest in birds. The moment is therefore ripe for an appeal upon their behalf, and for suggesting how a fitting memorial to him may be established.

The work which the Selborne Society has done in the Brent Valley Bird Sanctuary, in the way of preserving birds and testing nesting-boxes for use elsewhere, is well known and has some considerable value. The owners of the freehold wish now to develop their estate, and if the money necessary to buy the property is not forthcoming the sanctuary will go.

Matters have been made as easy as possible for us, and we have been asked only 4500*l*. for twenty-two acres of building land which comes into the London postal district.

May I, as chairman of the Bird Sanctuary Committee, invite the help particularly of those who are fond of birds and of open spaces to save the wood? Those who have been immediately interested in the work have subscribed 300 guineas to start the fund.

WILFRED MARK WEBB.

The Hermitage, Hanwell, W.7, July 10.

Researches on Growth of Plants.

By SIR JAGADIS CHUNDER BOSE, F.R.S.

I.—*The High Magnification Crescograph.*

INVESTIGATION on growth is a matter of much practical importance, since the world's food supply is intimately dependent upon vegetative growth. The movements of stems, leaves, and roots under the action of various forces, such as light, warmth, and gravity, are often due to minute variations in the rate of growth. The discovery of laws relating to the movement of growing organs thus depends on the accurate measurement of normal growth and its changes. The great difficulty of the investigation arises from the extraordinary slowness of growth, the average value of which per second may be taken as $\frac{1}{100000}$ in., or half the wave-length of sodium light. The "auxanometers" usually employed produce a magnification of about twenty times. Even here several hours must elapse before growth becomes perceptible, but during this long period the external conditions such as warmth and light would necessarily change, thus vitiating the results; moreover, autonomous variation of growth appears during lengthy periods. The elements of uncertainty can be removed only by reducing the period of experiment to a few minutes; but that would necessitate devising a method of very high magnification and the automatic record of the magnified rate of growth. I have been successful in this by my device of the High Magnification Crescograph, consisting of a system of two levers; the first magnifies a hundred times, and the second enlarges the first a hundredfold, the total magnification being 10,000 times. The various difficulties connected with the weight and friction at the bearing have been fully overcome.[1] The further difficulty in obtaining an accurate record of growth movement arising from friction of continuous contact of the writing point was removed by an oscillating device by which the smoked glass plate moves to and fro at regular intervals of time, say one second (Fig. 1). The record consists of a series of dots, the distance between successive dots representing magnified growth during a second (Fig. 2*a*).

The records may be taken on a stationary plate, first under normal, and then under changed, external conditions. The increase or diminution of space between successive dots in the two series demonstrates the stimulating or depressing nature of the changed condition (Fig. 2*d*); or the record may be taken on a plate moving at a uniform rate. In the curve thus obtained the ordinate represents growth-elongation, the abscissa the time. If a stimulating agent enhances the rate of growth, this fact is exhibited by a flexure in the curve upwards; a depressing agent, on the other hand, lessens the slope of the curve (Fig. 2*b*).

Precautions against Physical Disturbance.—The effect of vibration may be neutralised by placing india-rubber sponges under the legs of a heavy table supporting the apparatus. It is preferable to screw the supporting bracket on a wall. I have, indeed, been able to secure a magnification of ten million times with my Magnetic Crescograph in public demonstrations in busy London,

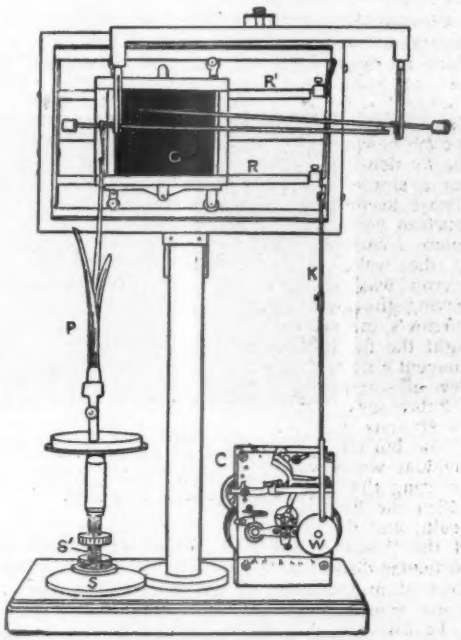


FIG. 1.—The High Magnification Crescograph. P, plant; S, S', micrometer screw for raising or lowering the plant; C, clockwork for periodic oscillation of plate; K, crank; W, rotating wheel.

the indication of the instrument being quite unaffected by the street traffic. In Fig. 2*c* is given the record on a moving plate taken with the High Magnification Crescograph. A dead twig had been substituted for the growing plant, and a perfectly horizontal record demonstrated the absence not only of growth, but also of all disturbance. There is an element of physical change in experiments on variation of the rate of growth under artificially raised temperature. In order to determine its character and extent, a record was taken with the dead twig of the effect of raising the temperature of the plant-chamber through 10° C. The record shows that there was an expansion during rise of temperature, which, however,

[1] For a fuller account see the author's "Researches on Growth and Movement in Plants by means of the High Magnification Crescograph," Proc. Roy. Soc., B, vol. cx., 1919. (The diagrams are reproduced with the kind permission of the Royal Society.) Also the following works published by Messrs. Longmans, Green, and Co.:—"Response in the Living and Non-living" (1902); "Plant Response" (1906); "Comparative Electrophysiology" (1907); "Irritability of Plants" (1913); "Life-movements in Plants," vols. i. and ii. (1918–19).

reached a limit, the record becoming once more horizontal. The obvious precaution to be taken in the study of variation of growth under change of temperature is to wait for several minutes for the attainment of steady temperature. The elongation caused by physical change abates in a short time, whereas the physiological variation in the rate of growth is persistent.

In Fig. 2*a* is given a record of growth of *Scirpus kysoor*; the growth per second magnified ten thousand times is 9·5 mm. The absolute rate of growth per second is therefore 0·00095 mm., or 0·95μ, where μ or micron is 0·001 mm.

Effect of Stimulus on Growth.—A generalisation was obtained that *all forms of stimuli, mechanical, electrical, or radiational, induce a retardation of the rate of growth;* under increasing intensity or duration of stimulus this retardation may culminate in an arrest of growth or even in actual contraction of the organ. As regards radiation, all rays of the vast æthereal spectrum (with the exception of red and yellow rays which cause photo-synthesis) are found to cause response by modifying the rate of growth of the plant. I have thus been able to obtain records of response of plants to long æther waves employed in signalling through space. (NATURE, October 30, 1919.)

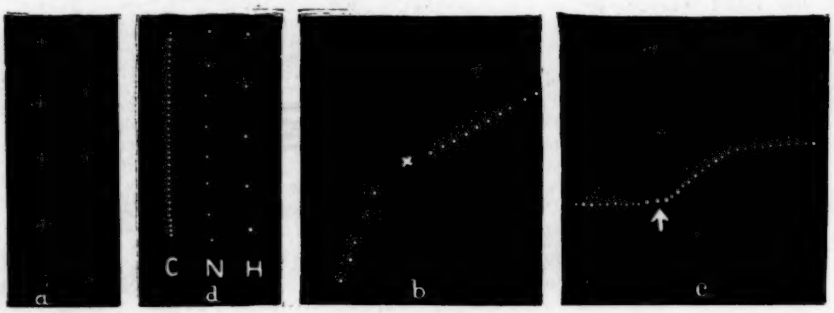


FIG. 2.—Crescographic records. *a*, Successive records of growth at intervals of 1 second; ×10,000, with a stationary plate. Effect of temperature: *d*, N, normal rate of growth; C, retarded rate under cold; H, enhanced rate under warmth; *b*, record on moving plate where diminished slope of curve denotes retarded rate under cold; *c*, horizontal record showing absence of growth in dead branch; physical expansion on application of warmth at arrow followed by horizontal record on attainment of steady temperature.

Effect of Sub-minimal Stimulus.—A very unexpected result was obtained under the action of sub-minimal stimulus, which induced an *acceleration* of growth instead of *retardation* under moderate intensity. This I find to be true of stimulation as diverse as that caused by electric shock, by light, and by chemical agents. A strikingly practical result was obtained with certain poisons which in normal doses killed the plant, but which in quantities sufficiently minute acted as an extraordinarily efficient agent for stimulating growth, the treated plants growing far more vigorously and flowering much earlier. It is only by the discovery of laws of growth that any marked advance in scientific agriculture will be rendered possible. We have been using a few stimulating agents, whereas there are thousands of the action of which we have no conception. The rule-of-thumb methods often employed in the application of a few chemical agents and of electricity have not been uniformly successful. The cause of the anomaly is found in the discovery of an important factor—namely, the dose of application—which had not hitherto been taken sufficiently into account.

The Balanced Crescograph.—The high sensitiveness already secured has been very greatly enhanced by the employment of the Null Method or the Method of Balance, where the rate of up-movement of growing tip is exactly compensated by the down-movement of the plant. A train of revolving clock-wheels, actuated by the fall of a weight, lowers the plant at the required rate. The exact adjustment is obtained by the right- or left-handed turning of a screw which regulates the governor. In this way the rate of growth becomes exactly compensated, and the recorder now dots a horizontal line instead of the former curve of ascent. The turning of the adjusting screw also moves an index against a circular scale so graduated that its reading at once gives the rate at which the plant is growing at the moment. When balanced, the recording apparatus is extremely sensitive, the effect of any change in the environment, however slight, being at once indicated by the upset of balance with the up or down movement of the indicator. I have in this way been able to detect induced variation in the rate of growth so exceedingly minute as $\frac{1}{2000000000}$ in. per second. An illustration of the delicacy of the method will be found in the record given in Fig. 3, on the effect of carbonic acid gas on growth; there is an immediate acceleration of growth (up-record), which continues for two and a half minutes; this is followed by retardation, as shown by the down curve. With diluted carbonic acid the acceleration may persist for a considerable time. As another instance of the delicacy of the method of balance, I obtained a decided response of the plant to the light so fleeting as that of a single electric spark the duration of which is of the order of $\frac{1}{100000}$ second.

The Magnetic Crescograph.—There is a limit to the magnification obtained by a compound

system of levers; an additional lever increases the weight and friction. For special research and for public demonstration a still higher magnification is necessary, and this I secured by the invention of the Magnetic Crescograph, where a fine magnetised lever causes by its movement a rotation

FIG. 3.—Record showing the effect of carbonic acid gas. Horizontal line at the beginning indicates balanced growth. Application of carbonic acid gas induces enhancement of growth, shown by up-curve, followed by depression, exhibited by down-curve. Successive dots at intervals of ten seconds.

of a suspended system of astatic needle with its attached mirror. By graduated approach of the suspended needle to the lever the magnification may be continuously increased from a million to ten million times. A concrete idea of the stupendous magnification will be obtained if we imagine the slow pace of the proverbial snail magnified ten million times. The 15-in. gun of the *Queen Elisabeth* throws out a shell with a muzzle-velocity of 2360 ft. per sec., but the crescographic snail would move twenty-four times faster than the cannon shot. The magnification of ten million times was obtained with a single lever, but a double lever will enlarge it a hundredfold—that is to say, it will give a total magnification of a thousand million times. The importance of this device for research in other branches of science is sufficiently obvious. For general purposes a magnification of a million times is sufficient; with ordinary precaution the apparatus may be rendered free from mechanical disturbance, and the zero-keeping quality of the indicating spot of light is quite perfect.

The following account of an experiment in demonstration of physiological response in a growing plant will be found interesting. The normal growth of the plant was indicated by the excursion of the spot of light through 6 metres in 10 secs. On introduction of chloroform vapour to the plant-chamber there was an immediate enhancement of the rate of growth, the spot of light moving three times faster. Continued action of the vapour of chloroform caused, however, a depression and arrest of growth; finally, there was a sudden contraction, which proved to be the spasm of death. Similar effects were produced by various poisons like the solution of potassium cyanide.

After this brief account of the very sensitive methods for the detection and record of the effect of stimulus on growth, I propose in another article to describe results which will offer an explanation of the tropic movements in plants induced by various stimuli of the environment.

Isotopes and Atomic Weights.

By DR. F. W. ASTON.

IN the atomic theory put forward by John Dalton in 1801 the second postulate was: "Atoms of the same element are similar to one another and equal in weight." For more than a century this was regarded by chemists and physicists alike as an article of scientific faith. The only item among the immense quantities of knowledge acquired during that productive period which offered the faintest suggestion against its validity was the inexplicable mixture of order and disorder among the elementary atomic weights. The general state of opinion at the end of last century may be gathered from the two following quotations from Sir William Ramsay's address to the British Association at Toronto in 1897:—

> There have been almost innumerable attempts to reduce the differences between atomic weights to regularity by contriving some formula which will express the numbers which represent the atomic weights with all their irregularities. Needless to say, such attempts have in no case been successful. Apparent success is always attained at the expense of accuracy, and the numbers reproduced are not those accepted as the true atomic weights. Such attempts, in my opinion, are futile. Still, the human mind does not rest contented in merely chronicling such an irregularity; it strives to understand why such an irregularity should exist. . . . The idea . . . has been advanced by Prof. Schutzenburger, and later by Mr. Crookes, that what we term the atomic weight of an element is a mean; that when we say the atomic weight of oxygen is 16, we merely state that the average atomic weight is 16; and it is not inconceivable that a certain number of molecules have a weight somewhat higher than 32, while a certain number have a lower weight.

This idea was placed on an altogether different footing some ten years later by the work of Sir Ernest Rutherford and his colleagues on radioactive transformations. The results of these led inevitably to the conclusion that there must exist elements which have chemical properties identical for all practical purposes, but the atoms of

which have different weights. This conclusion has been recently confirmed in a most convincing manner by the production in quantity of specimens of lead from radio-active and other sources, which, though perfectly pure and chemically indistinguishable, give atomic weights differing by amounts quite outside the possible experimental error. Elements differing in mass but chemically identical and therefore occupying the same position in the periodic table have been called "isotopes" by Prof. Soddy.

At about the same period as the theory of isotopes was being developed by the radio chemists at the heavy end of the periodic table an extremely interesting discovery was made by Sir J. J. Thomson, which carried the attack into the region of the lighter and non-radio-active elements. This was that, when positive rays from gases containing the element neon were analysed by electric and magnetic fields, results were obtained which indicated atomic weights roughly 20 and 22 respectively, the accepted atomic weight being 20·2. This naturally led to the expectation that neon might be a mixture of isotopes, but the weight 22 might possibly be due to other causes, and the method of analysis did not give sufficient accuracy to distinguish between 20·0 and 20·2 with certainty. Attempts were made to effect partial separation first by fractionation over charcoal cooled in liquid air, the results of which were absolutely negative, and then by diffusion, which in 1913 gave positive results, an apparent change in density of 0·7 per cent. between the lightest and heaviest fractions being attained after many thousands of operations. When the war interrupted the research, it might be said that several independent lines of reasoning pointed to the idea that neon was a mixture of isotopes, but that none of them could be said to carry the conviction necessary in such an important development.

By the time work was started again the isotope theory had been generally accepted so far as the radio-active elements were concerned, and a good deal of theoretical speculation had been made as to its applicability to the elements generally. As separation by diffusion is at the best extremely slow and laborious, attention was again turned to positive rays in the hope of increasing the accuracy of measurements to the required degree. This was done by means of the arrangement illustrated in Fig. 1. Positive rays are sorted into an extremely thin ribbon by means of parallel slits S_1 S_2, and are then spread into an electric spectrum by means of the charged plates P_1 P_2. A portion of this spectrum deflected through an angle θ is selected by the diaphragm D and passed between the circular poles of a powerful electromagnet O the field of which is such as to bend the rays back again through an angle ϕ more than twice as great as θ. The result of this is that rays having a constant mass (or more correctly constant m/e) will converge to a focus F, and that if a photographic plate is placed at GF as indicated, a *spectrum dependent on mass alone* will be obtained. On account of its analogy to optical apparatus, the instrument has been called a positive-ray spectrograph and the spectrum produced a mass-spectrum.

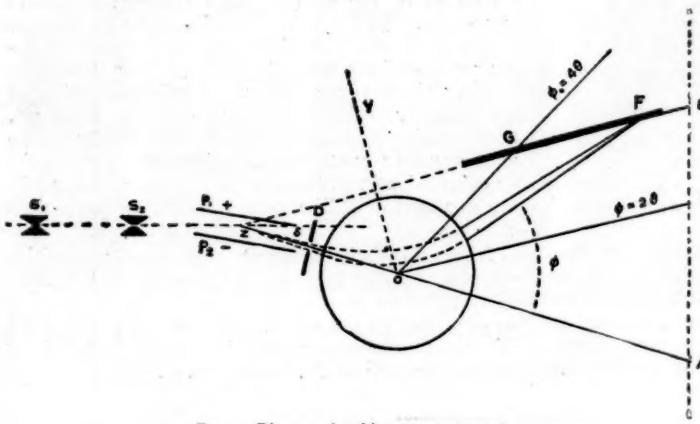


FIG. 1.—Diagram of positive-ray spectrograph.

Fig. 2 shows a number of typical mass-spectra obtained by this means. The number above the lines indicates the masses they correspond to on the scale O = 16. It will be noticed that the displacement to the right with increasing mass is roughly linear. The measurements of mass made are not absolute, but relative to lines the mass of which is known. Such lines, due to hydrogen, carbon, oxygen, and their compounds, are generally present as impurities or purposely added, for pure gases are not suitable for the smooth working of the discharge tube. The two principal groups of these reference lines are the C_1 group due to C (12), CH (13), CH_2 (14), CH_3 (15), CH_4 or O (16), and the C_2 group 24–30 containing the very strong line 28 C_2H_4 or CO. In spectrum i. the presence of neon is indicated by the lines 20 and 22 situated between these groups. Comparative measurements show that these lines are 20·00, 22·00, with an accuracy of one-tenth per cent., which removes the last doubt as to the isotopic nature of neon.

The next element investigated was chlorine; this is characterised by four strong lines 35, 36, 37, 38, and fainter ones at 39, 40; there is no trace of a line at 35·46, the accepted atomic weight. From reasoning which cannot be given here in detail it seems certain that chlorine is a complex element, and consists of isotopes of atomic weights 35 and

37, with possibly another at 39. The lines at 36, 38 are due to the corresponding HCl's.

Particles with two, three, or more electronic charges will appear as though having half, a third, etc., their real mass. The corresponding lines are called lines of the second, third, or higher order. In spectrum ii. the lines of doubly charged chlorine atoms appear at 17·5 and 18·5. Analyses of argon indicate that this element consists almost entirely of atoms of weight 40, but a faint component 36 is also visible. Spectra v. and vi. are taken with this gas present; the former shows the interesting third order line at $13\frac{1}{3}$. Krypton and xenon give surprisingly complex

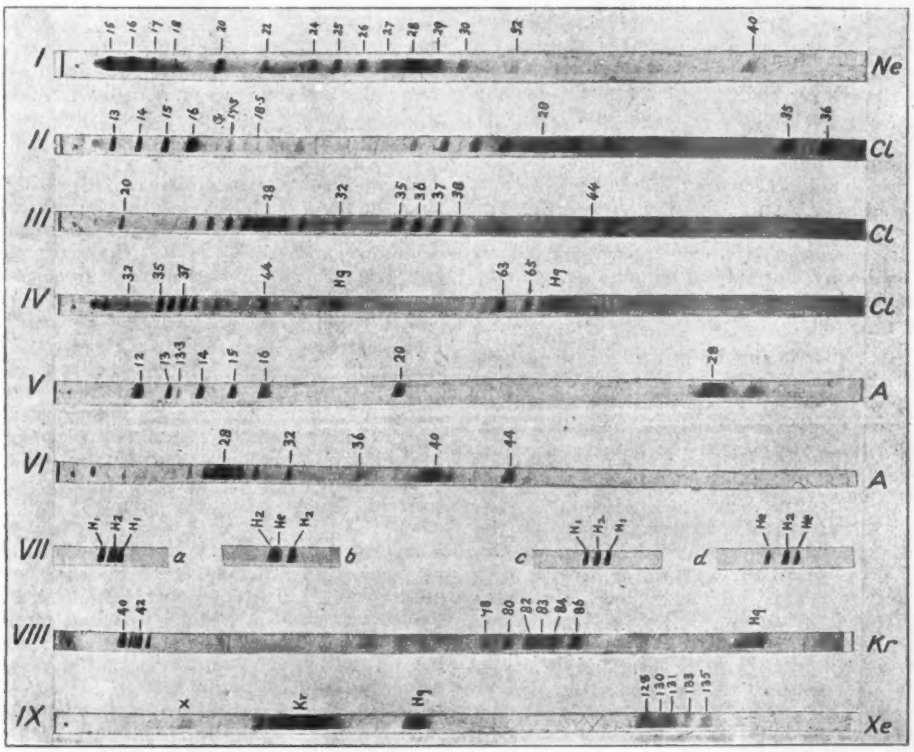


FIG. 2.—Typical mass-spectra.

results; the former is found to consist of no fewer than six isotopes, the latter of five (spectra viii. and ix.). Mercury is certainly a complex element probably composed of five or six isotopes, two of which have weights 202 and 204; its multiply charged atoms give the imperfectly resolved groups, which are indicated in several of the spectra reproduced in Fig. 2.

By far the most important result obtained from this work is the generalisation that, with the exception of hydrogen, all the atomic weights of all elements so far measured are exactly whole numbers on the scale O=16 to the accuracy of experiment (1 in 1000). By means of a special method (see *Phil. Mag.*, May, 1920, p. 621), some results of which are given in spectrum vii., hydrogen is found to be 1·008, which agrees with the value accepted by chemists. This exception from the whole number rule is not unexpected, as on the Rutherford "nucleus" theory the hydrogen atom is the only one not containing any negative electricity in its nucleus.

The results which have so far been obtained with eighteen elements make it highly probable that the higher the atomic weight of an element, the more complex it is likely to be, and that there are more complex elements than simple. It must be noticed that, though the whole number rule asserts that a pure element must have a whole number atomic weight, there is no reason to suppose that all elements having atomic weights closely approximating to integers are therefore pure.

The very large number of different molecules possible when mixed elements unite to form compounds would appear to make their theoretical chemistry almost hopelessly complicated, but if, as seems likely, the separation of isotopes on any reasonable scale is to all intents impossible, their practical chemistry will not be affected, while the whole number rule introduces a very desirable simplification into the theoretical aspects of mass.

Obituary.

MAJOR-GEN. WILLIAM CRAWFORD GORGAS, K.C.M.G.

IN St. Paul's Cathedral on July 9 a very remarkable tribute was paid to one who may fittingly be termed a Napoleon of Hygiene. On that day a military funeral was accorded to the remains of Major-Gen. William Crawford Gorgas, Surgeon-General of the United States Army and president of the American Medical Association. The impressive service was attended by a large concourse, including the Director-General of the Army Medical Department, who represented the King, the Director-General of the Medical Department of the Navy, the Presidents of the Royal Colleges of Physicians and Surgeons, the Presidents of the Royal Society of Medicine and the Royal Society of Tropical Medicine and Hygiene, and representatives of other learned societies and scientific institutions. Had the late Gen. Gorgas been a British subject such a tribute to his life and work would have been sufficiently noteworthy, but that a citizen and soldier of the United States should be honoured by these funeral rites is a unique testimony, not only to the man who fought and conquered yellow fever, but also to preventive medicine generally.

It is right that it should be so, and to no one could such an honour be more fittingly paid than to the man who devoted himself heart and soul to making the tropics healthy and habitable and, above all others, translated the pioneer scientific work of Laveran, Manson, Ross, Grassi, Finlay, and others into action.

Gorgas's life, one of ceaseless activity in the cause of science and humanity, began on October 3, 1854, when he was born at Mobile, Alabama, and terminated in the Queen Alexandra Military Hospital, London, on July 3. Death overtook him on his way to a new field of work, for he was taken seriously ill in England when *en route* to the West Coast of Africa with the view of studying the yellow fever problem there, a problem by no means solved and differing in some respects from that which presented itself in the New World.

Gorgas was a son of the South, his father being Gen. Josiah Gorgas, of the Confederate States Army, and his mother a member of a Southern family. He received his medical training at the Southern University, Tennessee, where he graduated A.B., and in 1879 he qualified M.D. at the Bellevue Hospital Medical College of New York University, thereafter holding a house appointment in the hospital.

In 1880 Gorgas joined the United States Army as a surgeon and served in various parts of the country, first coming into contact with yellow fever in Western Texas and himself suffering from an attack of the disease. His promotion in the service was rapid, and, his bent being towards the preventive side of medicine, the year 1898 saw him appointed Chief Sanitary Officer of Havana. At that time Havana was a hot-bed of yellow fever, and Surgeon-Major Gorgas found plenty of scope for his energies. While his colleagues Reed, Carroll, Agramonte, and Lazear established the *rôle* of *Stegomyia fasciata* as the vector of the then unknown parasite of yellow fever, Gorgas, as soon as he was certain of the facts, embarked wholeheartedly on an anti-mosquito campaign which in a remarkably short space of time freed Havana from the scourge of "Yellow Jack." It was then that he first displayed to the full those qualities of drive, tact, tenacity, firmness, and resolution which eventually gained for him the proud titles of "a Master-Administrator of tropical hygiene" and of "a Hercules of modern hygiene."

Gorgas had a wonderful way of getting at the heart of things. He was essentially practical, and this practicality, combined with enthusiasm and a devotion almost religious in character, found a still greater field in Panama. He was rewarded for his labours at Havana by being promoted Colonel and Assistant Surgeon-General in the United States Army, and it was in 1904 that he was sent to the famous isthmus to report upon the sanitary condition of the Canal Zone and to become ere long Chief Health Officer of an area which for centuries had been notorious for its unhealthiness, a region devastated by malaria and yellow fever and a veritable forcing-house for tropical pathology.

At first Gorgas had many difficulties. He was up against the Canal Commissioners; he was at loggerheads with the engineers; he found himself hampered by red-tape and restrictions of all kinds. Fortunately, the reins of power were at that time held in the United States by a man of very similar calibre to himself, and Theodore Roosevelt, realising all that depended on Gorgas's work, and having every sympathy with him and none for hide-bound traditions, swept away the obstacles from his path, and gave him a free hand and full responsibility. This was all Gorgas wanted. He knew, thanks to the work of Manson, Ross, and Finlay in the first place, and to the labours and sacrifices of his colleagues at Havana in the second, that he was on sure ground, and, backed loyally by the governor of the Canal Zone, Judge Magoon, he embarked with a worthy band of helpers and abundant sinews of war upon a campaign which speedily routed the forces of disease and death, rendered the Canal Zone not only habitable, but also healthy, and which will stand for all time as a monument to what can be done when science and administrative hygiene are given ample powers.

The results achieved induced Gorgas to put forward the theory, advanced also by Sambon and others, that if insanitary conditions are removed the white man can not only live and labour in the tropics, but also propagate his race there, and that his descendants will be healthy and virile. It is too early yet to say that this is wholly the case, but it is interesting to note what Gorgas said about this important question. Speaking of his work, he wrote:—

The real scope of tropical sanitation, which has been almost entirely developed within the last fifteen or twenty years, I believe, will extend far beyond our work at Panama. Everywhere in the tropics to which the United States has gone in the past fifteen years it has been shown that the white man can live and exist in good health. This has occurred in the Philippines, in Cuba, and in Panama, but the demonstration has been most prominent and spectacular at Panama, and therefore has attracted there the greatest world-wide attention. Here among our large force of labourers we had for ten years some ten thousand Americans—men, women, and children. Most of these American men did hard manual labour, exposed to the sun, rain, and weather conditions day in and day out, yet during that time their health remained perfectly good, just as good as if they were working at home. The same remark as to health would apply to the four thousand women and children who lived at Panama with their husbands and fathers. Both the women and children remained in as good condition as they would have been had they lived in the United States. This condition at Panama, I think, will be generally received as a demonstration that the white man can live and thrive in the tropics. The amount of wealth which can be produced in the tropics for a given amount of labour is so much larger than that which can be produced in the temperate zone by the same amount of labour that the attraction for the white man to emigrate to the tropics will be very great when it is appreciated that he can be made safe as to his health conditions at a small expense. When the great valleys of the Amazon and of the Congo are occupied by a white population more food will be produced in these regions than is now produced in all the rest of the inhabited world.

Panama made Gorgas famous; the Royal Society awarded him its Buchanan medal; the University of Oxford made him an honorary D.Sc.; the Liverpool School of Tropical Medicine presented him with its Mary Kingsley medal; and he was not forgotten in America. He did not, however, rest upon his oars. In 1913 the Chamber of Mines at Johannesburg sought his advice as regards the prevention of pneumonia among native miners on the Rand, and he proceeded to South Africa and carried out an investigation which led to useful results. He then turned his attention to South America, for the dream of his life—and no vain dream—was to stamp yellow fever out of the world. He made a survey of the endemic foci in South America, and then started to obliterate the worst of them at Guayaquil, in Ecuador. Here, again, his efforts and those of his assistants were crowned with success, and it is a tribute to his tact and discretion that so much could be accomplished in one of the lands of *mañana*, as some of the Spanish South American republics may be not inaptly called.

As director of the International Health Board of the Rockefeller Institute, a post to which he was appointed on the completion of the Panama Canal, Gorgas had excellent facilities for travel and investigation, and he became an apostle, as well as a priest, of the goddess Hygeia. As Surgeon-General of the United States Army, he had to organise the medical service for the Great War, and during the war he visited both France and Serbia, retiring, however, from the United States Army in 1918 under the age-rule.

Scarcely had hostilities ceased when his attention turned again to yellow fever, and along with Surgeon-Gen. Noble and Dr. Guiteras, of Havana, he was, as stated, on his way to the African West Coast, when he was stricken down by what proved to be a fatal illness. On his sick bed he was visited by the King, who conferred a K.C.M.G. upon him, and just before he took ill, when he was in Brussels at the Congress of the Royal Institute of Public Health, he was presented with the Harben gold medal, while at the recent annual meeting of the British Medical Association the University of Cambridge conferred upon him its honorary LL.D.

Gorgas died full of honours, if not of years. His work received its rightful recognition, and if he died comparatively early it must be remembered that his life was a very strenuous one, spent to a large extent in hot climates, and that he came very near to realising his lifelong ambition.

He was a man of resource and courage, but he was also a man with a kindly heart and a gratifying sense of humour. He knew how to handle those serving under him, and how to get the best out of them, while he gave credit where credit was due.

It has been said of him, sometimes bluntly, sometimes even rudely, that, in the strict sense of the term, he was not a scientific worker, but the fact remains that Gorgas worked ever on strictly scientific lines, and that the moment a scientific truth had been enunciated he was up and doing in order to apply it for the welfare of mankind. Without men of his stamp the labour of the microscopists would to a large extent be futile. His art was the natural corollary of the laboratory, and no more efficient exponent of it can be imagined.

As his coffin, shrouded by "Old Glory," borne by stalwart British Guardsmen, flanked by British medical officers of high rank, and followed by his widow and a distinguished company, passed up the aisle of St. Paul's, it was in keeping with his life's work that, amongst the wreaths waiting to be placed upon it, was one sent as a token of remembrance and esteem by his friend Sir Patrick Manson.

Notes.

THE exhibits of the Research Department, Woolwich, at the Imperial War Museum, Crystal Palace, illustrate some of the work vital to the war which was done there, and incidentally our unpreparedness, as much of it might have been done before. Amongst the specimens shown are the six isomers of T.N.T., isolated whilst devising new processes for the manufacture of the symmetrical variety, and for cheaply eliminating the undesirable isomers—a problem not yet fully solved. There are also specimens of amatol, which has largely replaced T.N.T. as a shell-filling; tetranitromethyl aniline, which is of increasing use as an initiator of detonation in others; trinitrobenzene, which should have a future, and many others. The exhibits of fragments of shells detonated by picric acid, T.N.T., and amatol respectively show by the relative numbers of the fragments that picric acid still remains our most shattering shell explosive, and, by the minuteness of most, how limited the killing range of such shells really is. The specimen of R.D.B. cordite illustrates how, when through lack of foresight our supply of acetone failed, our chemists and distilleries saved the situation by providing soluble nitrocellulose and alcohol-ether to gelatinise it. The sections of gaines show how the problem of detonating insensitive shell-fillings was solved during the war by employing a series of explosives in the detonator, and accomplishing in several steps what could not be done with certainty in one. The specimens which display the eroding effect of hot gases on gun-tubes present a problem to chemists which will probably be solved by the invention of a new alloy. An excellent series of X-ray photographs shows that great progress has been made in the penetration of metals. Internal flaws in parts are revealed, and also the internal structure of ammunition—an important matter when captured ammunition has to be examined and dissected. There are many other exhibits of interest.

THE appeal which the chairman of the Brent Valley Bird Sanctuary makes in our correspondence columns for funds with which to buy and endow the reserve which the Selborne Society has maintained for eighteen years will commend itself to most naturalists. It is as important to rear two useful birds as it is to make two ears of corn grow where there was but one before, and the sanctuary has done more than this. Not only has it enabled birds to build undisturbed near London, but its example has been followed elsewhere, and in thousands of gardens have birds been brought up where there were no fledglings previously. This is through the nesting-boxes which the committee has sent out. Such work should go on. A permanent sanctuary within the London area would be an excellent memorial to Gilbert White and crown the efforts of the Selborne Society. Although the gift of the purchase money or some substantial contributions would bring the endeavour to an earlier completion, we imagine that the more subscribers there are the better pleased would the committee be, and small amounts would therefore be welcomed.

THE fifty-seventh annual general meeting of the British Pharmaceutical Conference will be held at Liverpool on July 19–23 under the presidency of Mr. C. A. Hill, managing director of The British Drug Houses, Ltd., who will deliver his presidential address at the Royal Institution, Liverpool, on Tuesday, July 20. The British Pharmaceutical Conference is an organisation established in 1863, and during the fifty-six years of its existence it has made at its annual meetings a total addition of more than a thousand original researches to the common stock of chemical and pharmaceutical knowledge. Among the subjects of the scientific papers to be read at the forthcoming meeting are: A New Method for the Estimation of Cineole in Eucalyptus Oils; The Determination of Hydrocyanic Acid, of Nitrate in Bismuth Carbonate, and of Free Acetic Acid in Acetylsalicylic Acid; Aconite Alkaloids: An Improved Method for their Estimation; and The Detection of Inorganic Phosphate in Glycerophosphates.

WITH the view of obtaining further evidence as to the relationship of the Early Mousterian palæolithic flint implements to the Glacial Chalky Boulder Clay, excavations will be carried out shortly at High Lodge, Mildenhall, Suffolk, by Prof. J. E. Marr, Mr. J. Reid Moir, Mr. Reginald Smith, Mr. Henry Bury, and Mr. M. C. Burkitt. The owner of the High Lodge property, Sir Henry Bunbury, Bart., having given permission for the diggings to be conducted, it is hoped that it may be possible to ascertain with certainty whether the well-known brick-earth of Mousterian age occurring at this spot is younger or older than the Boulder Clay with which it is intimately associated. A full account of the excavations and the conclusions arising therefrom will be published in due course.

THE following elections in connection with the Royal College of Surgeons of England are announced:—*President:* Sir Anthony A. Bowlby. *Hunterian Professors:* Mr. C. W. G. Bryan, Mr. A. G. T. Fisher, Mr. W. S. Handley, Mr. W. G. Howarth, Prof. A. Keith, and Mr. H. Platt. *Arris and Gale Lecturers:* Mr. J. F. Dobson, Dr. F. W. Edridge-Green, and Mr. J. H. Evans. *Erasmus Wilson Lecturer:* Prof. S. G. Shattock. *Arnott Demonstrator:* Prof. A. Keith. *Pathological Curator:* Prof. S. G. Shattock. *Physiological Curator:* Mr. R. H. Burne. *Honorary Curator of the Odontological Collection:* Sir Frank Colyer. Sir D'Arcy Power is to deliver the next Thomas Vicary lecture.

THE VERY REV. DR. W. R. INGE, Dean of St. Paul's, is president for the new session of the Aristotelian Society which will open in November next.

THE Sir Alfred Jones Laboratories of the Liverpool School of Tropical Medicine will be officially opened by Lord Leverhulme on Saturday, July 24, at 2.30. The presentation of Mary Kingsley memorial medals will also be made.

SIR ROBERT JONES has been awarded the Cameron prize of the University of Edinburgh in recognition of his work in orthopædics. Earlier recipients of the prize, which is of the value of about 150*l*., were Pasteur, Lord Lister, and Sir Lauder Brunton.

DR. SEYMOUR HADWEN has resigned his position as Chief Pathologist in charge of the Biological Laboratory, Health of Animals Branch, Canadian Department of Agriculture, Ottawa, Canada, and become Chief Pathologist in the Reindeer Investigations of the Bureau of Biological Survey, U.S. Department of Agriculture.

WE are informed by the Department of Scientific and Industrial Research that the Research Association for the cutlery industry has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of the Committee engaged in the establishment of this association is Mr. W. H. Bolton, P.O. Box 49, Sheffield.

THE Royal Statistical Society has opened a register of the names of persons eligible for statistical posts. It has from time to time been asked to recommend qualified statisticians, and has taken this means of bringing those who have appointments to offer into touch with suitable applicants. A list of names and qualifications is now available, and the secretary (9 Adelphi Terrace, W.C.2) will be glad to furnish information accordingly.

WE learn from *Science* that Prof. L. H. Bailey is reorganising the American Pomological Society, of which he is president, and establishing junior branches in a number of agricultural colleges in the United States and Canada. It is proposed under the new scheme that the society shall give consideration to such national affairs as touch the growing of fruits, *e.g.* legislation, quarantine, export, transportation, and standardising methods.

CAPT. W. J. RUTHERFORD has reprinted from "The History of the Berwickshire Naturalists' Club" (vol. xxiv.) a paper on "A Border Myth: The Standing Stones at Duddo." The local folklore accounts for their origin by supposing that the stones are the petrified bodies of a gang of field-workers who profaned the Sabbath by going into a field singing and thinning a crop of turnips, while the leader was thrown on his back and lies prostrate to this day. Capt. Rutherford compares the legend with that attached to the "Maidens" or "Merry Maidens" and the "Hurlers" in Cornwall. The story is not uncommon, and it would not be difficult to quote other parallels.

THE report of the Felsted School Scientific Society for 1918 and 1919 is welcome evidence of the place given to scientific pursuits in an up-to-date school. The natural history notes, which predominate, reach a high standard and contain many interesting observations on the local appearance and movements of migratory birds, while the photographs which have been selected for reproduction say much for the skill and patience of the young naturalists. The report shows how greatly the progress of a school society depends upon the guidance of an enthusiastic master. It is gratifying to see from the balance-sheet that the governors, by a generous contribution to the funds of the society, give evidence of their belief in the value of Nature-study, and their faith is well founded, for the recording of detailed observations, whether of rainfall or temperature or migration, is a sowing of the seeds of the scientific habit and the love of truth.

UNDER the title "The Birds of Eastern Canada," the Canadian Department of Mines has issued a memoir—No. 3 of its Biological Series—by P. A. Tavener. This has been written "to awaken and, where it already exists, to stimulate an interest, both æsthetic and practical, in the study of Canadian birds and to suggest the sentimental, scientific, and economic value of that study; to assist in the identification of native species; and to furnish the economist with a ready means of determining bird friend from bird foe . . .; to present in a readily accessible form reliable data upon which measures of protective legislation may be based; to point out some of the pitfalls that have caught the inexperienced in the past; and to suggest methods for their future avoidance." To accomplish these desirable ends, the memoir treats of all the species with which the ordinary observer is likely to meet "between the Atlantic coast and the Prairies north of the International Boundary." It is prefaced by some general remarks on classification, geographical distribution, migration, and protection, and by an illustrated key to the characters of the groups to which the various species belong. The main portion of the work deals with 766 selected birds, and shortly describes their plumage, haunts, nesting, economic status, and distribution in Eastern Canada: many of them are depicted in the series of coloured plates which forms the concluding portion of this useful memoir.

IN the interests of commerce itself it is becoming increasingly plain that where the exploitation of wild animals is concerned men of science, and not the captains of industry, must determine the levy which any given species can stand without endangering its safety. The urgent need for the speedy recognition of this fact is very emphatically shown in a series of able essays published in the form of a bulletin by the Scripps Institution for Biological Research of the University of California (No. 9). Where all are of such surpassing excellence it is difficult to select any one of these essays for special mention. But since a choice must be made, it shall fall upon that of Dr. Evermann, who surveys the present position of the Northern fur-seal. He throws a lurid light on the attitude of the non-scientific legislator. Even Departments of State, he shows, for the sake of present revenue, will adopt covertly hostile methods to suppress the findings of scientific men appointed for the express purpose of investigating the conditions of the sealing industry, if such findings seem to threaten the earnings of that industry. The fact that, unless wise methods of conservation are adopted, the industry will presently extinguish itself seems entirely to be lost sight of in the desire to secure immediate revenue. "Take the cash in hand and waive the rest" seems to be the motto pursued. Those interested in the salmon fisheries contend that the seals eat vast quantities of these fish, and are therefore injurious to the fishing interests. Yet no attempt has so far been made to discover what fish really constitutes

the staple diet of the fur-seal. This aspect of the problem adds to its complexity, since it affects conflicting interests. At the same time it emphasises the need for immediate action, not for academic discussion.

THE many friends of the veteran geologist, Mr. Henry Keeping, who was born near Milton, on the Hampshire coast, in 1827, will welcome his simple and unaffected "Reminiscences," published as a pamphlet by F. W. Talbot, Sussex Street, Cambridge (price 1*s.* 6*d.* post free). A characteristic portrait appears on the cover. Anecdotes of Sedgwick and of the early days of collecting in Devonshire and the Isle of Wight form pleasant reading. The story of the plump farmer in the Fenland who checked a disaster by sitting in the gap of a broken dyke is told with humorous appreciation.

PROF. PIERRE TERMIER, in a paper on "Les Océans à travers les âges" (*Revue Scientifique*, May 8, 1920), emphasises the differences in structure of the Atlantic and Pacific Oceans, and regards the deep-water ring around the central area of the latter as a persistent feature of the crust, liable to disturbances, but not to elevation as dry land. The Indian Ocean, on the other hand, is post-Jurassic and the Atlantic is post-Miocene. The narrowing of the continents southwards is not a primary feature of a tetrahedral earth, but results from the widening of these comparatively modern areas of subsidence as they approach the south.

THE *Geographical Review* (New York) for March, 1920, contains two articles of especial interest to British readers. The first is by Lieut. Leo Walmsley on "The Recent Trans-African Flight," with several photographic illustrations. The writer's wide knowledge of Eastern Africa and his success as a scientific observer even when fighting from his aeroplane fully justify his remark that "Africa, as seen from the air, is one of the most wonderful of all countries. . . . A civilised country seen from the air is simply a gigantic mosaic . . . the airscape of Central Africa is as untamed and irregular as that of the moon." The second article is by Mr. C. R. Dryer on "Mackinder's 'World Island' and its American 'Satellite.'" The author cleverly shows, on Mollweide's projection, the American continents as a "world ring" round about the "world island," and pictures the people of that world ring, which has no barbarous heartland, as ready to come to the aid of the coastal races that stand for civilisation in the world island.

STONYHURST College Observatory has recently issued the results of meteorological and magnetical observations for 1919 with a report and notes by the director, the Rev. A. L. Cortie, S.J. The results with the report occupy 55 pages, and details of the observations are given with great precision for the several months and for the year. The observatory has long since been associated with the Meteorological Office, and the Monthly Weather Report publishes many of the results. The monthly mean temperature is obtained in two ways, from the mean of the highest and lowest daily readings and from the mean of the readings at 9 a.m. and 9 p.m., both means being corrected by Glaisher's tables. The thermometers are mounted 7 ft. above the ground in a Stevenson screen; why in this case should not the height above ground be 4 ft., the normal height for uniformity? Taken as a whole, 1919 was drier and colder than the normal, and every individual month was cold with the exception of May and December. Bright sunshine for the year was 25 hours less than the normal. Rainfall was nearly 6 in. deficient, although the rainy days were only two fewer than usual. October was relatively the driest month, rainfall being only about 50 per cent. of the average. Magnetic observations and disturbances are popularly explained, and afford considerable information for obtaining uniformity of results. Sun-spot activity, which had steadily declined since August, 1917, and throughout 1918, revived in 1919. The seismograph, which for a time had been thrown out of action, is said to be now working satisfactorily.

MR. J. I. GRAHAM, research chemist at the Bentley Collieries, Doncaster, has devised a very convenient and portable apparatus for the estimation of small quantities of carbon monoxide in the air of mines. It consists of a vessel containing a known volume of the sample, which can be introduced by running water out of the vessel. By operating a three-way tap and blowing water into the vessel the sample may be passed into iodine pentoxide contained in a **U**-tube heated to 90°–150° C. In examining air in the mine the temperature is maintained by hot oil contained in a thermos flask which keeps the **U**-tube within these limits for several hours. The iodine liberated from the pentoxide is thus sublimed and driven into a tube containing a solution of potassium iodide in which the free iodine can be titrated and estimated in the usual way. The inventor claims that an analysis can be completed in about five minutes with an accuracy of 0·005 per cent. using 100 c.c. of air, or of 0·0005 per cent. with 1 litre. It is of special value for estimating small quantities of carbon monoxide in mine-air, since 0·2 per cent. is highly dangerous, and even 0·02 per cent. produces after a time unpleasant effects. As the quality of compressed oxygen supplied in cylinders is important in life-saving operations in mines, Mr. Graham has introduced a simple piece of apparatus for determining the amount of oxygen by absorbing a known volume in alkaline pyrogallol. Both pieces of apparatus can be purchased from Messrs. Reynolds and Branson, Ltd., Leeds.

IN order to obviate the use of the high voltages required in wireless telegraphy when a triode tube is operated from a direct-current supply by means of a mechanical "chopper" which periodically breaks the supply circuit, Mr. L. M. Hull, of the Bureau of Standards at Washington, has used with great success an alternating supply from a 2-kw. machine giving 500 cycles per second at 150 volts, and a short account of his method and results is given in the Journal of the Washington Academy of Sciences for June 4. The sending key is in the alternator circuit, and the

filament current and plate potential are both provided by means of transformers. The author finds that, operated in this way, the triode tube gives results which compare favourably with those obtained with the usual direct-current method, and that it has the advantage of not requiring a high-voltage generator or battery, while over a limited distance signals may be received with a non-oscillating detector. A more complete account of this work is to appear as a Scientific Paper of the Bureau.

MR. S. J. PEACHEY, lecturer in chemistry at the College of Technology, Manchester, claims to have discovered a process for the cold vulcanisation of rubber. This is applicable not only to rubber in its solid forms, but also to solutions. The final product may be obtained containing no free sulphur. Leather waste, wood-meal, and starch cellulose may be mixed with rubber so as to yield cheap, fully vulcanised products with new properties and great durability. Leather waste and rubber may be converted into a product resembling leather, and at the same time waterproof. No details of the process are given beyond the fact that it employs "two gases which are by-products of several chemical manufacturing processes, and are available at a very low cost." If these claims can be substantiated, it appears that the process should be one of very great technical interest and importance.

FACILITY of manipulation and precision in adjustment are two prime features in X-ray tube stands. They appear to have been carefully considered in the models Mark III. and Mark IV. which we find in Bulletin 255 of Messrs. Watson and Sons, Ltd. In the screen attachment to the latter model there is an arrangement whereby the X-ray tube and the screen move together during vertical examinations. We would suggest that a valuable addition to the illustrations of these models would be the protective devices to be employed with them. It is especially necessary during screening examinations to avoid stray radiation reaching the operator, and the adoption of rigorous protective measures would no doubt become more general if publicity were given to this requirement.

IN the course of an article on Pelton-wheel construction by Mr. Percy Pitman, in *Engineering* for June 25, the author describes the method adopted for improving the jets, which were unsatisfactory in the existing turbine. Experimental nozzles were made in fluid-pressed bronze, and four rustless steel blades, 5 mm. thick, were dovetailed into them so as to lie in axial planes. These blades were ground and highly polished up to a thin knife-edge. A great improvement resulted; the jets were of extraordinary solidity and transparency, the water for about 2 ft. issuing almost like a glass rod. Those interested in the design of Pelton-wheel buckets will find a good deal of useful information in this article; there is but little of practical value in text-books, and the author gives the complete lay-out of the new buckets, and includes copies of the working drawings.

Our Astronomical Column.

AN EASY METHOD OF FINDING LATITUDE.—The *Observatory* for June contains an article by N. Liapin on a method of finding latitude which is interesting and a useful exercise for astronomical students, and requires no other instrument than a watch. The method consists simply in observing the number of seconds between first and last contacts of the sun with the horizon at sunrise or sunset. The formula for solution given by the author is $\cos^2 \text{latitude} = \sin^2(\text{sun's decl.}) + 4(\text{sun's radius})^2/(\text{time interval})^2$, where the radius and time interval must be expressed in the same units. This formula does not take account of the change of sun's decl. in the interval; a correction for this may readily be made.

Five actual determinations by this method are given, the resulting latitude being 10′ from the truth. While a sea horizon is preferable, any straight and level horizon will serve.

INCREASING THE PHOTOGRAPHIC POWER OF TELESCOPES.—In the Proceedings of the U.S. National Academy of Sciences for March Dr. Shapley describes a method of increasing the photographic power of large reflectors for the purpose of photographing extremely faint objects. The faintest stars at present reached by the 60-in. reflector are of magnitudes 20 to 21, and it is believed that the great Hooker telescope will gain about one magnitude over this. Dr. Shapley is of the opinion that this is bordering on the limiting magnitudes in globular clusters, and if one or two fainter magnitudes were available for study, some most important information might be obtained with regard to several questions of stellar and galactic evolution. The method employed is quite simple, consisting essentially in shortening the effective focal length of the telescope by means of a short focus lens placed between the mirror and the plate. The brightness of the image is thus increased, though, of course, a reduction of scale is inevitable. This, however, is immaterial in many sidereal problems. A trial series of exposures with different intensifiers seems to have yielded satisfactory results, and questions relating to globular clusters, the limits of the galactic system, and similar problems appear to be more hopeful of solution.

A NEW SPECTROPYRHELIOMETER AND SOLAR MEASUREMENTS MADE WITH IT.—In No. 378 of the Scientific Papers of the U.S. Bureau of Standards, recently issued, Messrs. W. W. Coblentz and H. Kahler give an account of a new spectropyrheliometer and measurements of the component radiations from the sun and from a quartz-mercury vapour lamp. The spectropyrheliometer consists of a quartz spectrograph and cylindrical condensing lens placed upon an equatorial mounting, thus eliminating the ultra-violet absorption produced in heliostat mirrors. The paper sums up the data given on the relative components of infra-red, visible, and ultra-violet radiation from the sun and from a quartz-mercury arc lamp, also on the gas-filled tungsten lamp, the iron arc, and the carbon arc. In the first appendix methods are given for excluding ultra-violet light from buildings, one of these being the use of a kind of Venetian blind or louvre of wide slats, painted buff to reflect the light into the building, the buff or red paint absorbing the ultra-violet, thus protecting the contents of the building (balloon hangars, etc.) from photochemical action. The second appendix suggests methods for protecting projection lantern films from the heat of the lamp, and a simple method put forward is to provide the water-cell with windows of Corning "heat-absorbing" glass, which is very opaque to infra-red radiation.

British Association.

SUBJECTS FOR DISCUSSION AT THE CARDIFF MEETING.

THE sectional programmes for the British Association meeting at Cardiff, August 24–28, are now taking shape, and some of the principal scientific subjects which will be discussed may be indicated. The Mathematical and Physical Section, under the presidency of Prof. A. S. Eddington, will be concerned with the Einstein theory, and will receive a paper on the shift of the Fraunhofer lines with reference to that theory. The Section will also discuss the examination of materials by X-rays, the origin of spectra, terrestrial magnetism, auroræ, solar disturbance, and various phenomena of the upper atmosphere. The Geological Section will, as usual, pay attention to local geology, and will also, in joint session with the Sections of Zoology and Botany, discuss Mendelism and palæontology with reference to the Mendelian interpretation of gradual changes, especially when new characters appear late in the individual life-cycle. The Zoological Section will also consider the need for the scientific investigation of the ocean and of fisheries—a subject in which not only the president of the Section (Prof. J. Stanley Gardiner), but also Dr. W. A. Herdman, president of the Association and professor of oceanography at Liverpool University, are leading authorities.

The president of the Geographical Section, Mr. J. McFarlane, will deal in his address with geography and nationality as factors in the formation of the new Europe; the Section will also discuss the distribution of population in South Wales, the new Ordnance Survey maps, the place of geography in a reformed classical course, and various problems connected with Abyssinia, Algeria, Tunisia, Asia Minor, Finland, and other lands. The Engineering Section is expecting papers from Sir Arthur Duckham on the use of coal and from Mr. S. F. Edge on farm tractors, and will also deal with a number of metallurgical and mechanical topics. The Anthropological Section will consider several subjects of Welsh interest, including Welsh ethnology, the Roman sites at Caerwent and Abergele, "hill-top" camps, especially in North Cardiganshire, and Welsh folk-music; in this Section also, among other speakers, Prof. Flinders Petrie is expected to give an account of recent work in Egypt. The Physiological Section, jointly with its sub-section of Psychology, will deal with the subject of psychological medicine in the United States, while the Section will also consider the place of physiology in education, and will receive from Prof. A. D. Waller a demonstration of the "emotive response" of the human subject. The erection of psychology into the subject of a separate section will be brought forward.

The Sections of Physiology and Botany jointly will discuss biochemistry and systematic relationship. The Botanical Section, in addition to other joint meetings, will join that of Agriculture in dealing with soil and plant survey work. In the Educational Section the report of a committee will be received upon training in citizenship, in connection with which Bishop Welldon, Sir R. Baden-Powell, and Lady Shaw are expected to speak. The Section, among other subjects, will discuss the relation of schools to life, post-graduate international education, and the relation of universities, public schools, training colleges, and higher technical schools to a national system. In connection with the last discussion it is hoped to receive a communication on universities from the Right Hon. H. A. L. Fisher. A number of papers of psychological and educational interest will be received in joint session with the sub-section of Psychology. The Agricultural Section will have before it a number of practical subjects concerned with crops and livestock.

In addition to general excursions, several Sections, including those of Geology, Geography, Engineering, Anthropology, Botany, and Education, will visit sites, works, or institutions in Cardiff and the neighbourhood appropriate to their various interests.

The subjects of the evening discourses given at general meetings will be "A Grain of Wheat from the Field to the Table," by Sir Daniel Hall, of the Board of Agriculture, and "Some Requirements of Modern Aircraft," by Sir Richard Glazebrook, lately director of the National Physical Laboratory.

Museums Association Annual Conference.

THE thirty-first annual conference of the Museums Association was held in Winchester on July 6–8, under the presidency of Sir Martin Conway, Director-General of the Imperial War Museum. There were present about a hundred delegates from the various museums and art galleries of Great Britain and Ireland, while Colonial and foreign institutions were represented by Mr. Fitzroy Carrington, from the Boston Museum of Fine Arts; Mr. E. C. Chubb, from Durban Museum; and Dr. G. Johansson Karlin, from the Kulturhistoriska Museet, Lund.

The meeting marked an epoch in the history of the association, since it partook of the nature of a joint conference with the Museums Association of France, which was represented by Prof. Louis Roule, of the Paris Museum, and Dr. Loir, secretary of the French Museums Association.

In his presidential address Sir Martin Conway gave an account of the formation of the Imperial War Museum temporarily housed in the Crystal Palace. He explained how the difficulties of the collection and transport of specimens are being met, and dealt with some of the problems of their storage, especially in the case of war kinematograph films the preservation of which at present is both difficult and expensive. Owing to the vast mass of material collected and the large size of many of the exhibits, the president pointed out that their permanent home must of necessity be spacious. He suggested that no more fitting war memorial could be raised than a stately museum on the Surrey bank of the Thames near the proposed site of the new Charing Cross bridge. Here the thousands of specimens connected with and illustrating the war period could be housed, and with them a complete Roll of Honour, with biographical notes, of every man and woman of the Empire who had fallen in the great struggle.

Mr. E. N. Fallaize read a paper of great interest and utility to museum curators on "Suggestions for the Classification of the Subject-matter of Anthropology." In consideration of the vast field covered by this subject, he pointed out the necessity for the formation of a definite plan for its study, suggesting a broad classification of the subject into two heads, one dealing with man as an organism and the other treating him as a rational being reacting to his environment. For the first, a study of man's structure and the functions of his organs is needed, including a study of the abnormal, both physical and mental. Having thus established a type, the second heading falls naturally into two groups: ethnology, a study of man in space, and what may be termed palæanthropology, a study of man in time. In addition, man's nature as shown in the development and employment of specifically human faculties should be studied, not chronologically, but in a logical sequence

leading from primitive gratification of the senses to man's relation to the unseen.

One of the outstanding problems which a museum curator has to face is that of the lighting of his building, and a paper given by Mr. Hurst Seeger on "The Lighting of Museums and Art Galleries" was particularly instructive on this point. He dealt especially with the question of reflection in the glass of pictures and museum-cases, and pointed out those principles of construction whereby such reflections could be avoided.

Mr. Lowe explained the Public Libraries Act of 1919, stating that, in his opinion, it gave their charter to the museums and art galleries of this country.

A discussion as to the desirability of a diploma for museum curators was opened by Dr. Hoyle, who was of opinion that without some recognised diploma the status of curators could not be assured. In the course of the discussion Mr. Bailey outlined a scheme suggested by Sir Cecil Harcourt-Smith for the training of museum curators at the Victoria and Albert Museum.

A paper on the museum and art gallery of Baroda, dealing particularly with the difficulty of preserving pictures in hot climates, was read by Mr. Dibden.

Mr. M. J. Rendall, Headmaster of Winchester College, gave a paper, illustrated by lantern-slides, on the teaching of art in local museums, emphasising the part played in such teaching by good lantern-slides. He demonstrated the vast difference made by the quality of the slides used, and explained how and where the best slides could be obtained.

Dr. A. Loir gave an account of the formation of an Association of Curators of French Museums, and suggested a joint committee of English and French curators for international co-operation. Papers were read on "The Winchester City and Westgate Museum," by Mr. Hooley; "The Winchester College Museum," by the Rev. S. A. McDowall; "Selection of Pictures for Municipal Art Galleries," by Mr. Howarth; "Biography of the Comte de Lacépède," by Prof. Louis Roule; "The Child and the Mummy," by Mr. T. Peart; and "Suggestions for a Bureau of Exchange through the Medium of the *Museums Journal*," by Mr. Allchin.

A full account of all papers and discussions will be published in the September issue of the *Museums Journal*.

The University of Edinburgh.

NEW SCIENCE BUILDINGS.

THE foundation-stone of the new chemical laboratories of the University of Edinburgh, the first of what will be known in future as the "King's Buildings" of the University, was laid on July 6 by the King, who was accompanied by the Queen and Princess Mary. These buildings are to be erected as separate blocks on a site of 115 acres acquired by the University in November, 1919, mainly for the use of the scientific departments. They are situated on the southern outskirts of the city, near the Royal Observatory on Blackford Hill, and are about two miles distant from the Old College. Thousands of spectators assembled, notwithstanding the drenching rain which fell before and throughout the ceremony.

The general lay-out of the chemical laboratories was planned by Prof. James Walker, who has worked in collaboration with Mr. A. F. Balfour Paul, the architect of the building. The building is rectangular in plan, having a frontage of 220 ft. and a depth of 320 ft. Three corridors, one central and one on each side, run backwards through the whole length, and are connected by a cross-corridor in the front portion. This arrangement permits of indefinite extension by increasing the depth of the building. Between the central corridor and the side corridors are situated the main laboratories with their stores- and service-rooms, as well as the lecture department. Each main laboratory (of which there are five) measures 70 ft. by 45 ft., and receives north light from a saw-tooth roof. Smaller rooms used in conjunction with the main laboratories are situated across the outer corridors, and are lit from the side. The whole building is of one story, except the frontage block and the front part of the east and west wings, which are two stories in height. In these will be housed administration, library, special laboratories, and research-rooms. When complete the department will provide places for about four hundred students working simultaneously. It is estimated that the total cost of the chemical laboratories with fittings and equipment will be approximately 250,000*l*.

His Majesty, in replying to the address of the Vice-Chancellor, Sir Alfred Ewing, expressed the hope that generous donors would be found able and willing to complete the plan of extension which had been sketched with so bold a hand. At the conclusion of the ceremony of laying the foundation-stone the degree of LL.D. was conferred on the Queen.

Lessons from the Smithsonian.

THE report of the secretary of the Smithsonian Institution for the year ending June 30, 1919, is, as always, full of interest, and it differs from similar reports issued in this country in that the points of interest are clearly brought out and not left to be deduced by the reader from masses of undigested detail. The institution controls the work of the National Museum, the Bureau of American Ethnology, the International Exchange Service, the National Zoological Park, the Astrophysical Observatory, and the United States contributions to the International Catalogue of Scientific Literature. The Astrophysical Observatory seems a little out of the picture, but the association of the other bodies tends to co-operation and the prevention of overlap.

The National Museum itself embraces every form of museum activity and combines subjects which in London are distributed among the two sections of the British Museum, the Victoria and Albert Museum, the Science Museum, the Museum of Practical Geology, the National Galleries of Art, and several other collections. The Washington people are as well satisfied with their system as we (to judge from perennial complaint) are dissatisfied with ours. The single administration, it is claimed, "not only ensures greater economy in management, but permits of a more logical classification and arrangement, the elimination of duplication, and a consequent reduction in the relative amount of space required."

Those in this country who are advocating the co-ordination of our museums and allied establishments under a single board would be well advised to study the conditions in Washington. The most obvious danger of such a system is too great rigidity and unnecessary red-tape. It is, however, clear that such an objection does not apply to the Smithsonian Institution. The constitution of the various bodies permits of far more flexibility and enterprise than we are accustomed to in some, at any rate, of the similar bodies in this country. This, it seems to us, is because the Smithsonian is not a Department of State run by politicians or clerks without experience of the varied

activities which they have to direct, but is, from Secretary Walcott downwards, managed by men who have received their training in the field or the laboratory or the museum; men who are familiar with the needs and difficulties of their assistants; men who combine high ideals with a clear appreciation of what is practicable, and so carry out a consistent policy.

A feature of the National Museum, as of other American museums, is the large amount of exploration undertaken. An expedition, including collectors and kinematographers, is now at work in Africa. Mrs. Purdy Bacon has bequeathed fifty thousand dollars to establish a travelling scholarship for the study of faunas outside the United States. Many other expeditions are here reported on. But we would chiefly emphasise the policy of sending out the officers of the museum to study and collect. The whole of the geological staff was thus employed during the field-season of 1918, filling gaps in the collections, obtaining specimens needed for public exhibition, and taking photographs to illustrate the explanatory labels. Many of the other departments also had members in the field.

Among other signs of life and growth, the report records the inauguration of popular scientific lectures, and the introduction of a Bill to provide a museum of history and of the arts as a memorial to Theodore Roosevelt. The building would afford much-needed space for the rapidly extending National Gallery of Art.

The Religion and Origin of the Hawaiian People.

THE sixth volume of the Memoirs of the Bishop Museum at Honolulu[1] continues the publication of Judge Fornander's literary collections. The first portion contains two important papers by native writers on the religion of the Hawaians. One, by Kamakau, contributed to the collection by Dr. W. D. Alexander, describes certain ancient ceremonies of which the principal are those connected with the prenatal development of the royal child, the direction of services to the gods, the catching of the fish *opelu*, and the feasts of the year. There are shorter notes on heathen prayers and the ceremonial erection of the *heiau* or god's house. A much longer paper by the Hawaian author, S. N. Haleole, deals with the functions of the *Kahuna*, "the priesthood called the Order of Sorcery." The word in varying forms (*tahuna, tahunga, tauna*) is used throughout the Eastern Pacific to denote persons possessed of varying degrees of wisdom from priesthood to sorcery, but in the west, in Tonga and Samoa, has become entirely secularised, and there (in the form *tufunga*) means nothing more than a carpenter or skilled workman.

The *Kahuna* in Hawaii was properly trained for his office, and gave evidence of his powers by divination from pebbles, clouds, shadows, and dreams, and by his magical effects with the *maunai* or cast-away portions of nail, hair, tooth, or clothing. His services were in request in times of war and threatened evils, for house-building or loss of lands, in courtship and medicine. The omens of agriculture, canoe-making, and fishing, with descriptions of the occupations themselves, are fully described.

The second part of this volume contains Fornander's speculations on the "Source and Migrations of the Polynesian Race." This appears somewhat out of date in the present stage of linguistic study. The author regards India as the original home of the Polynesian people, and supposes that the Polynesian and Aryan language families separated before the latter had developed their inflected form, and that traces of Polynesians are found in the Malay Archipelago. A majority of the immigrants are thought to have passed through Torres Straits to the Loyalty Islands, and thence to Fiji, Samoa, and Tonga. Fornander's so-called evidence is very unsatisfactory. It is based mainly on the casual resemblances of certain Indian words to Polynesian, the Polynesian meanings being read into the Indian word or *vice versa*.

The theory of an Indian origin of Polynesian may be seen to underlie the theories of Macmillan Brown, Percy Smith, Christian, and Churchill, but certainly lacks the support of sound linguistic evidence. According to this view, everything east of India which agrees with modern Polynesian is borrowed from an ancient form of Polynesian speech, though the languages themselves prove that Polynesia has received many of its words from primitive Indonesia, and that not by one migration, from one place at one time, but in several colonisations from various parts of the archipelago at different times.

The final portion of part 2 contains other papers by Fornander on Hawaian tradition, history, and genealogy.

As all the native writings in the first part are in the original Hawaian with translations, they form a considerable body of text which will be useful to the student of the language, quite apart from their value in the exposition of Hawaian religion. The whole work is very clearly and tastefully printed and a credit to the Museum Press. SIDNEY H. RAY.

1 Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History. Vol. vi., Nos. 1 and 2. "Fornander Collection of Hawaiian Antiquities and Folk-Lore." Third Series. Parts 1, 2. Pp. 358. Honolulu: H. I. Bishop Museum Press, 1919.)

Soil Temperatures.[1]

THE paper by Messrs. West, Edlefsen, and Ewing referred to below is an attempt to predict the probable temperature of any hour of any day. If the mean monthly temperatures of any place are known from previous records, it is possible to represent them by a Fourier series of the form

$$T = a + b\cos(\theta - c) + d\cos 2(\theta - e) + f\cos 3(\theta - g) + \ldots$$

where T = temperature at time θ, a = mean annual temperature, b, c, etc. = constants. It is also found for normal days that the temperature at any given hour is a certain percentage of the mean daily temperature, and that this percentage is practically constant irrespective of season. The Fourier series is used to predict the mean daily temperature, which is then multiplied by the appropriate percentage factor to obtain the temperature at the given hour. An arithmetical method, avoiding the use of the Fourier series, is also described. The results are fairly trustworthy for arid regions, but not for humid areas where storms, etc., are frequent.

In Capt. Franklin's third paper on soil temperatures (see "Forecasting Frosts," NATURE, January 1, 1920, p. 450) the variations in the ratio of temperature ranges at the 4-in. depth and the surface, $\left(\frac{R_4}{R_0}\right)$, are studied under a variety of weather conditions. The values vary widely, from 0·19 in a very dry soil to 0·85 during heavy rains. The most common value is about 0·40. The influence of the soil-water on tem-

1 "Determination of Normal Temperatures by Means of the Equation of the Seasonal Temperature Variations, and a Modified Thermograph Record." By F. L. West, N. E. Edlefsen, and S. Ewing. *Journ. Agric. Res.*, vol. xviii. (1920), p. 499.

"The Effect of Weather Changes on Soil Temperatures." By T. B. Franklin. Proc. Roy. Soc. Edinburgh, vol. xl. (1920), p. 56.

perature is very marked. The downward percolation of warm or cold rain from the surface to the 4-in. depth causes rapid changes in temperature, especially in sandy soils, when percolation is rapid. After drainage has ceased a rise in temperature may enable it to begin again, owing to the diminishing viscosity of water with increasing temperature. The formation of a dry surface-mulch reduces the value of $\left(\frac{R_4}{R_0}\right)$ owing to the low conductivity of dry soil. But the actual *temperature* at the 4-in. depth is not greatly reduced by the poor conductivity of the dry soil. This is attributed to the dry surface layers reaching a higher temperature owing to their lessened specific heat, and this counteracts the effect of decreased conductivity. It is shown that a strong dry wind causes the temperature of the surface soil to fall considerably below that of the air. The effect of frost is examined and a formula given for depth of soil frozen in terms of mean surface temperature and duration of frost. A very close relation holds between the date of flowering of coltsfoot and the number of frosts for the two months previous to the date of flowering on open soil not covered with deep snow. It is shown also that strong warm west winds—associated with cyclonic depressions—rapidly raise the temperature of the underground layers of soil in spring. B. A. K.

Control of Insect Pests.

ENGLISH tomato-growers in the Lea Valley are threatened with an annual loss of from 5*l*.–10*l*. per acre unless special remedial measures are adopted against the glasshouse tomato moth, *Polia* (*Hadena*) *oleracea*. L. Lloyd (Monthly Circular of the Lea Valley and District Nurserymen's and Growers' Association, Ltd.) finds that spraying with lead arsenate for the destruction of the pest must be supplemented by trapping the caterpillars and moths and by destruction of the pupæ. The caterpillars can be trapped in old sacks, and ultimately killed by boiling water, while the moths are attracted to wide-mouthed jars containing brown treacle and ale mixed with 1 per cent. of sodium fluoride. Emphasis is laid on the necessity for ascertaining that each control measure is effective.

Several papers have recently been published dealing with the control of various "borers" that infest crop trees. Attempts have been made to control the peach-borer by means of toxic gases derived from poisonous substances distributed on the soil round the base of the trees, E. B. Blakeslee (Bull. 796, U.S.A. Depart. Agric.) finds that the more usual toxic agents, viz. carbon bisulphide, carbon tetrachloride, sodium cyanide, and naphthalene, are all unsuitable for various reasons, but that para-dichlorobenzene offers distinct possibilities for the purpose. The surface crust about the collar of the tree is broken, the required dose of poison (about 1 oz. per tree from 6–15 years old) distributed evenly about the trunk in a band 1–2 in. wide, and a covering of earth applied and moulded up. It is claimed that by this method 94 per cent. of the larvæ can be destroyed.

Much damage is wrought in the United States by the apple-tree borer, which usually takes two or three years to pass through its life-cycle. It is difficult to attack the larvæ by means of poisonous sprays, and mechanical devices are necessarily resorted to. F. S. Brooks (Farmers' Bull. 675, U.S.A. Depart. Agric.) maintains that the most effective method of control is the old-fashioned practice of "worming" with a knife and a piece of wire, but recommends the use of carbon bisulphide when the burrows are obstructed and the larvæ cannot be reached by the wire. Egg-laying can be prevented by a thick coat of paint applied to the bark of the tree, or by means of wrappings of cloth or newspapers applied close enough to exclude the adult female from the bark. The beetle can be killed by spraying the trees with arsenate of lead, as by this means their food is poisoned, but it is doubtful if this is profitable as a general rule.

A most comprehensive account of the toon shoot and fruit borer (*Hypsipyla robusta*, Moore) is given by C. F. C. Beeson in the *Indian Forest Records* (vol. vii., part vii.). The stages of the insect, its life-history and habits, and studies of its seasonal history are fully described, and from the information thus gained the best methods of control are elucidated. The toon borer passes through five generations in the year; the first is spent in the flower, the second in the developing fruits, and the last three in the young shoots of the current season. The effect of this habit is that the first and second broods cause great injury to the seed crop, and in bad years may hinder seed-formation entirely, whilst the three later broods may completely nullify the season's growth in young trees, and, in any case, they cause great delay in the development of the saplings. It is often of little use to make young plantations in the neighbourhood of old toon trees which are infested with the borer. The young trees are subject to attack from their second or third year onward, but may be somewhat protected by banding the trees breast-high with sacking, and removing and destroying at intervals all the larvæ and cocoons found inside the sack-bands. After the fruits are ripe it is advisable to cut out and burn all shoots that are attacked, and in bad cases a second pruning should be made during the cold weather.

Scientific and Systematic Pomology.[1]

IT may be taken as a sign of the development of research in fruit culture in this country, and of the interest which has been aroused in connection therewith among growers of fruit and progressive horticulturists generally, that the well-known firm of nurserymen, Messrs. George Bunyard and Co., Ltd., of Maidstone, has considered the time ripe for the issue of a new quarterly journal devoted exclusively to pomology. The editor, Mr. E. A. Bunyard, a member of the firm named, is recognised both as a practical grower of wide experience and as one of the foremost authorities on systematic pomology and pomological literature. Under his guidance the *Journal of Pomology* should without difficulty establish itself as a publication of scientific value, meeting the needs of a branch of horticulture which has advanced with rapid strides in its importance for the country economically and physiologically since the day when the late Mr. W. E. Gladstone advised farmers to grow fruit for jam production as a remedy for agricultural depression, and is at present none too well catered for in this respect.

The contents of the first two numbers may appear to suggest that there is scarcely occasion yet for a periodical intended primarily to serve for scientific and systematic pomology in this country, some of the more important articles being reprints or abridgments of papers previously published in other journals. Such articles, however, as those by Miss Sutton on self-sterility in plums, cherries, and apples, and by Brooks and Bailey on silver-leaf disease, are of a

[1] *The Journal of Pomology*. Edited by Edward A. Bunyard. Vol. i. Nos. 1 and 2. (Maidstone: Geo. Bunyard and Co., Ltd.) Published Quarterly. Single Nos. 3*s*. 6*d*.; Annual Subscription 10*s*.

degree of interest to pomologists which justifies reproduction in a journal more likely to come under their notice than those in which they originally appeared. It is improbable, moreover, that with research bearing on fruit culture in active progress at such centres as Woburn, Long Ashton, and East Malling, as well as at Cambridge and the John Innes Institution at Merton, there will be any dearth of material on the scientific side for future numbers.

In addition to the articles mentioned, others of particular interest which have already appeared in the journal are those on "Black Currant Varieties," by R. G. Hatton; "Seedling Apples," by the editor and Edward Laxton; "Insect Visitors to Fruit Blossom," by C. H. Hooper; and "The Recognition of Fruits," by H. E. Durham.

Provided that the policy already adopted of the inclusion of reviews and short summaries of recent pomological research as well as of original papers is maintained, those whose interests are mainly centred on fruit culture should find this journal of much service in keeping them in touch with the advance of knowledge in the subject—a matter which has not been easy hitherto owing to the diversity of the publications in which such work has appeared.

University and Educational Intelligence.

BIRMINGHAM.—At a Degree Congregation held on July 10 the Vice-Chancellor (Sir Gilbert Barling, Bart.) conferred the following degrees:—*Doctor of Science:* Frederick Challenger, Arthur Hubert Cox, Harold Ashley Daynes, and John Leslie Haughton. *Doctor of Medicine:* Gladys Mary Cooksey. *Philosophiae Doctor* (a degree new to this University): William Hulse, Frederick Joseph Meggitt, and Leonard Johnston Wills. *M.Sc. (Official):* William Cramp, Arthur Robert Ling, Gilbert Thomas Morgan, Samuel Walter Johnson Smith, and Richard Henry Yapp. *M.Sc. (Ordinary):* F. H. Clews, H. J. Collins, H. G. Evans, A. E. Goddard, F. B. Jenkins, L. J. Lambourn, E. W. Mason, K. N. Moss, A. H. Naylor, N. A. Nicholls, D. S. Newey, A. J. Nicholson, G. N. Scott, H. J. Thompson, E. Tyler, and W. R. A. Weatherhead. *Master of Surgery:* B. T. Rose.

In addition to these, 107 candidates were admitted to the degree of B.Sc. and 16 to the degree of M.B.

The honorary degree of Master of Music was conferred on Sir Thomas Beecham and Francis Donald Tovey.

BRISTOL.—The resignation of Prof. F. Francis as dean of the faculty of science is announced. Prof. A. M. Tyndall is to succeed him in the office, with Mr. P. Fraser as deputy dean.

Prof. C. Lloyd Morgan, on relinquishing his chair, has been appointed emeritus professor of psychology and ethics.

Dr. C. D. Broad has been appointed to the chair of philosophy.

CAMBRIDGE.—Dr. T. M. Lowry, C.B.E., has been elected professor of physical chemistry in the University. This is a first appointment to a newly created chair.

LIVERPOOL.—Dr. W. Mason has been appointed professor of engineering (strength of materials), Mr. C. O. Bannister professor of metallurgy, and Mr. W. H. Gilmour professor of dental surgery.

LONDON.—The King has been pleased to approve the appointment of Mr. Ernest Barker, fellow and tutor of New College, Oxford, to the office of Principal of King's College in succession to the late Dr. R. M. Burrows.

Applications are invited for the William Julius Mickle fellowship, which is awarded annually to the man or woman who, being resident in London and a graduate of the University, has, in the opinion of the Senate, done most to advance medical art or science within the preceding five years and shown conspicuous merit. The fellowship is of the value of at least 200*l.* Applications must reach the Principal Officer of the University by, at latest, the first post on October 1 next.

MANCHESTER.—The King, on the recommendation of the Chancellor and Council of the Duchy of Lancaster, has contributed 100 guineas to the appeal fund.

The Manchester correspondent of the *Times* announces that Mr. Maxwell Garnett, Principal of the College of Technology, has resigned, and is asking to be relieved of his duties at the end of the summer vacation. He adds:—"There has for some time past been acute controversy between the Principal and the Education Committee regarding the former's policy of raising the educational status of the college, which constitutes the Department of Technology in Manchester University. The Education Committee recently decided to limit the number of degree students and to admit a certain number of senior technical-school boys as whole-time students. In communicating this decision to candidates for admission to the degree courses, Mr. Garnett suggested the possibility of its reversal by the City Council. The Education Committee published its censure of this letter, and both the policy of the committee, which was represented in the debate as an emergency policy for a single year, and the censure were endorsed by the City Council last week." Under Mr. Garnett's guidance the educational work of the college has developed greatly, the number of matriculated students being now more than six times greater than it was when he became Principal eight years ago. The demand for graduates from the college is far greater than the supply, and there has been a ready response to the appeal for funds for the purpose of extending its highest work.

MR. W. M. CUMMING, hitherto of the British Dyestuffs Corporation, Ltd., has been appointed senior lecturer in organic chemistry at the Royal Technical College, Glasgow.

TWO Frecheville research fellowships, each of the yearly value of 300*l.*, tenable for one year, and possibly for a second year, are being offered by the Imperial College of Science and Technology, South Kensington. The fellowships are intended to aid in carrying out any investigation or research connected with mining, mining geology, metallurgy, or the technology of oil considered by the selection committee to be of sufficient use or promise. Applications, in writing, giving particulars of the proposed investigations of candidates, should be made to the Secretary of the College by, at latest, August 31 next.

THE following bequests, among others, were made by the late Mr. T. W. Backhouse, whose death was reported in NATURE of May 13 (p. 335):—50*l.* to the British Association; 700*l.* to his trustees upon trust, to apply the same as they in their absolute discretion may consider expedient towards the carrying on of the scientific calculations based upon observations and notes made by him in astronomy, meteorology, or other branches of science, and towards the publica-

tion of them, any sum remaining over being given to the British Association; and all his astronomical journals and drawings of Jupiter and Mars to the British Astronomical Association. His trustees are to complete and publish the star maps for tracing meteor paths now in process of completion under the care and charge of Sir William Peck, of The Observatory, Edinburgh.

A SUMMER meeting of the Association of Technical Institutions will be held at Cambridge on Friday and Saturday, July 23–24. The proceedings will commence on the Friday at 10 a.m., when the president, the Marquess of Crewe, will take the chair. Papers will be read on Friday morning by Principal J. C. Maxwell Garnett on a national system of education and by Principal C. Coles on the necessity for close co-operation between technical colleges and the universities. On Saturday morning Principal C. L. Eclair-Heath will read a paper on the relations which should exist between the day continuation schools and the central technical college, and Principal L. Small one on adult education in relation to the work of technical schools. Resolutions dealing with adult education will be submitted at the conclusion of the reading of Principal Small's paper.

WE are notified by the Board of Education that the removal of the main offices of the Board from the Victoria and Albert Museum, South Kensington, to King Charles Street, Whitehall, is in progress, and will, it is hoped, be completed by the end of the present month. On and after July 26 the official address of the Board will be Whitehall, S.W.1. It is requested that only urgent communications shall be sent until after July 24, and that these shall be marked "Urgent" on the outside wrapper. The Medical Branch of the Board is at Cleveland House, 19 St. James's Square, S.W.1. The Pensions Branch is at the Science Museum, Imperial Institute Road, South Kensington, S.W.7. The Examinations Section of the Board is housed at 49 Cromwell Road, South Kensington, S.W.7. The office of Special Inquiries and Reports and the Library will remain for the present at the Victoria and Albert Museum. Visitors whose business solely concerns these branches should call at the addresses given above.

THE activity of the scientific society of a school may be taken as a measure of the interest aroused in scientific subjects and a sign of progressive teaching. Clifton College occupies a high position, judged by this standard, and its scientific society, founded so long ago as 1869, continues to foster the inborn aptitude of many young people for observation and experiment. We have before us a list of exhibits at a conversazione given by the society on July 8, and we do not hesitate to say that the demonstrations, apparatus, specimens, and collections shown would do credit to any scientific society. The demonstrations included wireless telegraphy and telephony, the artificial formation of clouds, the fixation of nitrogen, the fractional distillation of petrol from crude petroleum, and other subjects, and the exhibits illustrated many interesting facts and phenomena of biological and physical science. The conversazione was held to show to parents and friends the work and resources of the scientific society, and we are sure that the company must have been impressed by what was displayed. Clifton College is renowned among the public schools for its attention to science, and the recent conversazione shows that it is able to maintain the high place gained for it by men like Wilson, Shenstone, Worthington, and Rintoul.

Societies and Academies.

LONDON.

Royal Society, June 24.—Sir J. J. Thomson, president, in the chair.—Sir Ray **Lankester**: Some rostro-carinate flint implements and allied forms. A series of rostro-carinate flint implements is described and figured in this paper from various localities, including one from the Lower Palæolithic gravel of the valley of the Oise (France). It is shown that the form exhibited by the "Norwich test specimen," with ventral plane, dorsal plane or platform, anterior rostrum, with dorsal carina or keel, is modified in some of the specimens here figured by the "flaking away" of the ventral plane and by the hook-like curvature of the rostrum. A large Sub-Crag example is described, in which only one of the characteristic features of the type, namely, the great ventral plane, is retained, the implement serving as a very efficient "jack-plane." The evidence of the manufacture of these implements by a series of humanly directed blows is indicated by the illustrative drawings.—Lord **Rayleigh**: A re-examination of the light scattered by gases in respect of polarisation. I.: Experiments on the common gases. Re-determinations are given of the relative intensity of the two polarisations in the light scattered at right angles by pure gases. The paper is chiefly concerned with developing accurate experimental methods. The values obtained are as follows:

Gas	H_2	N_2	Air	O_2	CO_2	N_2O
Intensity of weak component polarisation ... (Strong component = 100.)	4·51	4·74	5·68	10·1	12·4	16·1

—A. **Mallock**: Note on the influence of temperature on the rigidity of metals. The experiments here described were carried out at the Davy Faraday Laboratory as a continuation of a somewhat similar set on the temperature-variations of Young's modulus (see Proc. R.S., A, vol. xcv.). The method adopted in the present series depended on the determination of the periods of a torsion balance the restitutive couple of which was given by the rigidity of a specimen of the metal tested at various temperatures. The coefficients of temperature-variation found for rigidity agreed with those for Young's modulus in so far that in both cases the variation diminished as the melting point of the metal increased. The chief value, however, of the present experiments was in showing that the natural plasticity or internal friction of metals (which leads to what has sometimes been called hysteresis) was even more affected by temperature than were the coefficients of elasticity, and that the value of "rigidity" obtained from the observed periods was very appreciably affected by the variation of plasticity. For this reason the numerical results are not given in the paper, but the method of experiment is described and the nature of the errors introduced by the change of plasticity stated.—E. F. **Armstrong** and T. P. **Hilditch**: A study of catalytic actions at solid surfaces. V.: The rate of change conditioned by a nickel catalyst and its bearing on the law of mass-action. The hydrogenation of selected simple organic compounds containing one ethylenic linkage has been studied with reference to the indications of a linear relation between the amount of hydrogenation and time which were observed in the case of mixtures of unsaturated glycerides (part i. of this series). It is now found that this relation, in the case of methyl and ethyl cinnamates, safrol, or anethol (when hydrogenated in the liquid state in presence of nickel at 140° or 180° C.), takes a linear

form for at least 60 per cent., and in most cases 80 to 90 per cent., of the whole action. The interpretation of the mechanism of the action which the authors deduced from the work on unsaturated glycerides thus receives experimental confirmation.—H. **Jeffreys**: Tidal friction in shallow seas. In a recent paper G. I. Taylor has shown that the friction of the tidal currents in the Irish Sea over the bottom causes enough dissipation of energy to account for about one-fiftieth of the known empirical secular acceleration of the moon. This suggests that other and larger shallow areas within strong tidal currents will contribute a still greater amount to the dissipation of energy, and in the present paper the chief shallow seas of the earth are treated separately. The greatest dissipation is found to take place in the Bering Sea, the Yellow Sea, and the Strait of Malacca. Altogether, enough is found to account for about 80 per cent. of the secular acceleration, leaving a balance to be explained by currents in fjords and along the open coast.—Prof. J. C. **McLennan**, J. F. T. **Young**, and H. J. C. **Ireton**: Arc spectra *in vacuo* and spark spectra in helium of various elements. (1) The vacuum arc spectra of antimony, bismuth, calcium, magnesium, silver, and copper, and the spark spectra in helium of antimony, bismuth, aluminium, cadmium, lead, magnesium, thallium, and tin, have been investigated in the region below $\lambda=1850$ A.U. (2) The measurements of the arc spectra of antimony, bismuth, calcium, and selenium, and the spark spectra of antimony and lead, appear to be the first recorded for these elements in this region. (3) The work with the vacuum grating spectrograph has resulted in the extension of the vacuum arc spectrum of copper to about $\lambda=1216$ A.U.—Prof. J. C. **McLennan** and A. C. **Lewis**: Spark spectra of various elements in helium in the extreme ultra-violet. In this investigation the spark spectra in helium of the elements silicon, tellurium, molybdenum, and zirconium have been determined for the spectral region between $\lambda=1900$ A.U. and $\lambda=1600$ A.U.—K. H. **Kingdon**: Low-voltage ionisation phenomena in mercury vapour. (1) By the use of a magnetic field experimental proof has been given that when mercury-vapour atoms are bombarded with electrons possessing volt-velocities greater than 4·9, the atoms may be ionised by these collisions. (2) An attempt has been made to explain the experimental results of Davis and Goucher on the basis of the results obtained. (3) Arguments are presented for showing that the production of ions in mercury vapour at this voltage is not so definitely at variance with the Bohr theory as might at first be thought. (4) The experiments go to show that the low-voltage ionisation is not due to ionisation by successive impacts, but that perhaps, in order that a 4·9-volt collision should produce ionisation, the velocity of the impinging electron must bear some definite orientation with regard to the orbit of the electron which is to be ejected from the atom.—Sir George **Greenhill**: Electrification of an insulated lens and allied problems treated by the stream function.—C. **Chree**: Simultaneous values of magnetic declination at different British stations. A comparison is made of corresponding diurnal variations of magnetic declination at Eskdalemuir and Kew observatories. Mean monthly, daily, and hourly values of declination at Eskdalemuir, Stonyhurst, Falmouth, and Kew are compared. The results are also given of the measurements of a large number of irregular declination changes at the several stations. It is found that the differences between different stations increase with the amount of magnetic disturbance, and that if accurate information is desired as to magnetic declination anywhere in the field, observations taken on disturbed days should not be relied on. It is thus important that observatory records should be consulted before the results of field observations are accepted. A number of results are obtained as to the relative amplitudes of irregular declination changes at the several observatories.—J. **Mercer**: Symmetrisable functions and their expansion in terms of biorthogonal functions. The purpose of this communication is to announce certain results relative to the expansion of a symmetrisable function $\kappa(s,t)$ in terms of a complete system of fundamental functions corresponding to $\kappa(s,t)$, regarded as the kernel of a linear integral equation. An expansion of the function of positive type by which $\kappa(s,t)$ is symmetrisable is obtained and applied in two important cases.—W. F. **Sheppard**: Reduction of error by linear compounding. The paper deals with the general problem of improving an observed quantity which contains an unknown error by adding to it a linear compound (linear function) of other observed quantities, called auxiliaries, the coefficients in the added portion being chosen so as to make the mean square of error of the whole a minimum. This is a generalisation of the special problem of finding the improved value when the auxiliaries are the differences of sufficiently high order of a set of quantities. The treatment of the problem is simplified by a brief statement of general theorems, and by a theory of conjugate sets of quantities. The object is to arrive at formulæ suitable for numerical calculation.—G. B. **Jeffery**: Plane stress and plane strain in bipolar co-ordinates. The solution is given for a flat, elastic plate bounded by two circles when under stresses applied over its boundaries. Curvilinear co-ordinates are employed, for which the co-ordinate curves form a double set of orthogonal coaxial circles. Important particular cases are: (1) A circular plate with an eccentric circular hole: (2) a semi-infinite plate bounded by a straight edge with a circular hole; and (3) an infinite plate containing two circular holes. The differential equation of the stress function is solved for these co-ordinates, the stress function is obtained for given arbitrary stresses applied over the boundaries, and expressions are deduced for the stresses and displacements produced at any point of the plate.—R. O. **Street**: The tidal motion in the Irish Sea: Its currents and its energy. Certain general relations are obtained from the Laplacian dynamical theory connecting the form of the tidal wave and the magnitude of the surface current on a sea of limited extent rotating with the earth. In continuation of a former paper, these are applied to the recorded data for the Irish Sea, and the agreement is found to be fairly satisfactory. A second approximation to the hydrodynamical problem for a rotating tidal basin is then effected, and by means of the relations thus obtained the mean rates of transfer of water and of energy across certain vertical sections placed transverse to the direction of the flood-stream in the Irish Sea are computed from the existing hydrographical data. The results show that there is a residual flow of water northwards through this region of such magnitude that the Irish Sea would empty itself through the North Channel about three times a year, while the tidal flow of energy from all causes which takes place into this area is at the mean rate of about 6×10^{17} ergs per second. The result of this estimate of the flow of energy into the area is in general agreement with an independent one made recently by Mr. G. I. Taylor (Phil. Trans., A, vol. ccxx., 1919, pp. 1–33). If we could assume that this energy is all dissipated, the result would be about 250 times the viscous dissipation calculated directly by the writer in a previous paper (Roy. Soc. Proc., A,

vol. xciii., 1917, pp. 348–59), on the assumption of smooth laminar tidal motion throughout the region.—W. G. **Palmer**: The catalytic activity of copper. Part i. Simple apparatus is described for the measurements by chronograph records of the reaction velocities at different temperatures of a typical catalytic action—that of the dehydrogenation of alcohol by copper. Details are given of the methods used in preparing a reproducible contact material. After oxidation and reduction a second time the copper showed an activity of unchanged value. It is shown that copper prepared electrolytically is quite inactive as a catalyst, in spite of great variation in the conditions of its deposition. Copper reduced from its oxide was active at temperatures above 200° C., but this activity depended on the temperature at which the metal was reduced from its oxide.—S. **Barratt**: The origin of the "cyanogen" bands. (1) Observations have been made of the spectra of the flames of a number of gases containing carbon, hydrogen, nitrogen, and oxygen. (2) The cyanogen bands are strongly developed in the coal-gas-nitrous oxide flame. (3) Evidence has been obtained that they are entirely absent from the hydrogen-nitrous oxide flame if all traces of carbon are excluded, and it appears to follow that the presence of carbon is essential to their production. (4) The appearance of the cyanogen bands is, under appropriate conditions, a more delicate test for carbon than that of any of the other bands associated with that element. On the other hand, this spectrum is not necessarily developed when both carbon and nitrogen are present. (5) The conclusion of Grotrian and Runge that the cyanogen spectrum is to be attributed to nitrogen is shown to rest on assumptions which are not confirmed in the present investigation. (6) The cyanogen spectrum provides a very delicate test for the presence of compounds of nitrogen when admitted in the form of a gas to hydrocarbon flames burning in air, since elementary nitrogen does not appear in ordinary circumstances to be effective in producing the cyanogen bands in such flames. (7) The intensity of the cyanogen bands when carbon compounds are admitted to the hydrogen-nitrous oxide flame bears no simple relation to the amount of carbon thus added.—F. **Horton** and Ann C. **Davies**: The effects of electron collisions with atmospheric neon. The critical velocities for electrons in neon were investigated by methods similar to those employed with helium and argon. It was found that neon differed from these gases in showing more than one critical velocity both for radiation and for ionisation, these critical velocities being detected under conditions such as to preclude the possibility of any of them being due to the displacement or removal of a second electron from the atom.—A. G. **Bennett**: The occurrence of diatoms on the skin of whales. With an appendix by E. W. Nelson. The author states that the skin of certain fin whales and blue whales captured in sub-Antarctic waters is discoloured by a superficial film of a buff colour, resembling in tint the coloured bands often observed on floating ice. Whales thus affected are nearly always fat. Microscopic examination showed that this film consists of immense numbers of diatoms. The fat individuals are probably those which have spent some time in the far South, where the supply of whale-food is very abundant during the summer. There is reason to believe that the thin individuals are recent arrivals from warmer water. The skin of these thin specimens appears to be free from any noticeable film of diatoms; their light parts are thus white instead of having the yellow tinge which has given rise to the name "sulphur-bottom" applied by the whalers to whales in which the light parts are yellowish. The cutaneous film of Antarctic "sulphur-bottoms" may be composed of the same diatoms as those which form the coloured bands on ice.—R. W. **Wood**: An extension of the Balmer series of hydrogen and spectroscopic phenomena of very long vacuum tubes.—F. W. **Aston** and T. **Kikuchi**: Moving striations in neon and helium. When an induction-coil spark is passed through a spectrum tube containing neon, and the discharge observed with a rotating mirror, it is seen to consist of bright striations moving from the anode towards the cathode. When first observed the velocity was found to be roughly that of sound in the gas. Further investigations now show that this is only a limiting case of a very complex phenomenon. The velocity is found to decrease with increase of pressure, and also to depend on the bore of the tube. The effect of change of temperature has been investigated, and curves are given showing that at constant volume the effect is much greater than the expansion coefficient. At constant pressure the temperature effect comes in only at high temperatures, when it is probably due to impurities liberated from the tube. Helium is found to give much the same sort of results as neon. Experiments with mercury vapour and other gases are also described. No satisfactory theoretical conclusions have yet been arrived at, and further experiments are in progress.

Geological Society, June 23.—Mr. R. D. Oldham, president, in the chair.—O. **Holtedahl**: The Scandinavian mountain problem. A brief account is given of the history of research regarding the Scandinavian mountain problem, which deals with the superposition of highly metamorphosed, often gneissose, rocks upon slightly altered fossiliferous Cambro-Silurian sediments. From a consideration of the phenomena in the mountain-belt of deformation it is inferred that the age of the displaced materials depends upon the angle of inclination of the thrust-planes and their depth. Though the thrusts have extended downwards for a considerable distance, they have not generally, in the author's opinion, reached below the level of the pre-Cambrian plane of denudation, and no true Archæan rocks could, as a rule, have been tapped. In support of these conclusions some of the tectonic features of two districts are indicated: (1) Finmarken, in Northern Norway, and (2) the southern part of the Sparagmite area near Randsfjord, in South-Central Scandinavia. Brief descriptions are given of the rock-groups in Finmarken and their structural relations. Special attention is directed to the structure of the Alten district, where the main tectonic feature is a highly undulating thrust which does not intersect the pre-Cambrian floor. Regarding the Randsfjord district, the original order of succession of the strata is indicated from the Holmia shale to the close of the overlying Cambro-Silurian sediments. Pressure from the north in Late Silurian time developed imbricate structure in these sediments, but such displacements are not supposed to have affected the pre-Cambrian floor. As investigation proceeds it seems to become increasingly evident (1) that the highly metamorphic sedimentary rocks of the middle and northern parts of the eastern mountain-belt are mainly of earlier Ordovician age, while those west of the Sparagmite region in the south-western mountain district are chiefly of Silurian age, and (2) that the igneous materials associated with these highly metamorphosed sediments are younger intrusive rocks.

Aristotelian Society, July 5.—Prof. Wildon Carr in the chair.—Dr. W. F. **Geikie-Cobb**: Mysticism, true and false. The application of the term "mystic" to current psychic phenomena was unwarranted. True mysticism was an immediate apprehension of the one

as the good rather than the true; it possessed a positive, personal, unquestioning quality which is a necessary feature of all moral valuation, and belonged to the world of the "excessive," and therefore was, *per se*, beyond logic. All attempts to communicate the mystic experience were limited to the use of symbols, and, therefore, by their very nature doomed to partial failure. Those symbols, however, were not selected arbitrarily by the conscious mind, but drawn from the storehouse of the unconscious. Mysticism differs from "extroversion" in that its supreme interest is in the one who is at once another and the ground of the mystic's being. The truth of mysticism is implied in the truth of the self as transcendental, a truth without which the empirical self loses most of its value. But mysticism is not adequately defined as a form of feeling, and what has led to its being so defined is the fact that not thought, but love, is the distinguishing function of all true mystic experience. If an air of unreality surrounds the utterances of mystics, it is only for those who are strangers to love. He who loves eternal beauty holds its transitory appearances as of lesser worth. Dante, for example, at the height of his vision saw love enthroned, and declared that it was love which moved the sun and the other stars. Before this supreme experience of love it would seem that all discursive thought was foredoomed to silence as a worshipper in the outer court of reality.

DUBLIN.

Royal Dublin Society, June 22.—Dr. F. E. Hackett in the chair.—Prof. W. **Brown** and P. **O'Callaghan**: The change in the rigidity of nickel wire with magnetic fields. Transverse magnetic fields, both direct and alternating, have the reverse effect on the rigidity of nickel that direct or alternating longitudinal magnetic fields have; that is, for the former there is an increase, and for the latter a decrease.—Prof. G. H. **Carpenter**: Injurious insects observed in Ireland during the years 1916–17–18. The paper contains records of injury to apple fruitlets by capsid bugs, as recently noticed in England, and also by beech weevils (*Orchestes fagi*), as observed by Theobald in Devonshire in 1912. There are also accounts of the feeding of *Ptinus tectus* in stores of casein and in carpets.—A. G. G. **Leonard** and Agnes **Browne**: Some derivatives of nitrotoluidine (4-nitro-2-amido-1-methylbenzene). The following compounds obtained by the diazotisation of nitrotoluidine [NH_2 : Me : NO_2 = 1 : 2 : 5] and suitable coupling have been described: Nitromethylphenylazo-β-naphthol, bright red needles, m. p. 204° C.; nitromethylbenzenediazoamino-*o*-toluene, yellow needles, m. p. 133° C.; nitromethylbenzenediazoamino-*p*-toluene, yellow hexagonal plates, m. p. 131° C.; nitromethylaminobenzene-*p*-sulphonic acid, yellow amorphous substance, m. p. 129° C.; methylnitrodiazoamino-*p*-nitrobenzene, yellow amorphous powder, m. p. 118° C.; and 2-methyl-5-nitro-2′:4′-dihydroxyazobenzene, yellow amorphous powder, m. p. 234° C.—The late Prof. **McClelland** and the Rev. H. V. **Gill**: An investigation into the causes of the self-ignition of ether-air mixtures. When a mixture of ether and air is allowed to expand suddenly into an evacuated tube 3 ft. long and of about 3 in. diameter, it is found to ignite. This ignition is often followed by an explosion which may shatter the tube. The authors describe experiments made to determine the temperatures at different parts of the tube when pure air is used instead of the mixture. A thermo-couple was employed. The increase of temperature following on the inrush of air was found to be a maximum near the closed end of the tube, and to decrease in positions further from the end. The length of the tube has an important effect on the rise of temperature. In the case of a tube 3 ft. long the temperature reached was 193° C. From results arrived at by other methods it appears that this temperature is sufficient to cause the ignition of ether-air mixtures. Theoretical considerations were dwelt on. It is proposed to investigate further certain points of interest connected with this effect.

PARIS.

Academy of Sciences, June 28.—M. Henri Deslandres in the chair.—L. **De Launay**: The course of the Coal Measures in the Central Massif and at its edges. An attempt to deduce some general considerations upon which experimental borings can be placed in the Paris basin.—L. **Maquenne** and E. **Demoussy**: A case favourable to the action of copper on vegetation. A study of the influence of traces of copper salts on the water-culture of lettuce, peas, and wheat.—Em. **Bourquelot** and H. **Hérissey**: The presence in the melilot and woodruff of glucosides furnishing coumarin under the hydrolysing action of emulsin. The fresh plants (*Melilotus officinalis*), extracted with boiling water, gave a solution containing traces only of free coumarin, but the same liquid after treatment with dilute sulphuric acid gave crystals of coumarin on distillation, proving that the coumarin was combined, probably as a glucoside. The plant was shown to contain an enzyme also capable of hydrolysing the glucoside. Similar results were obtained with *Asperula odorata*.—A. **Righi**: Relativity and a scheme for a decisive experiment.—Ch. Ed. **Guillaume**: Values of the expansions of standard nickel-steels. In the preparation of nickel-steels certain amounts of manganese and carbon are necessarily present. For the standard of reference a nickel-steel containing 0·4 per cent. manganese and 0·1 per cent. carbon has been chosen, and the effects of varying amounts of these elements upon the expansion have been based on this as a type. The results are condensed in two curves representing the values of the two coefficients, α_{20} and β_{20}, of the equation of expansion.—G. J. **Rémoundos**: The modulus and zeroes of analytical functions.—J. **Chazy**: The course of the movement in the problem of three bodies when the time increases indefinitely.—E. **Belot**: The origin of solar and stellar heat.—A. **Véronnet**: The temperature of formation of a star in an indefinite homogeneous nebula.—M. **Gouineau**: Verification of the thermo-electricity of liquid mercury. C. Benedicks has recently proved experimentally the existence of a new thermo-electric effect produced in a homogeneous metallic circuit by an asymmetrical distribution of temperatures. The results verify and complete those of M. Benedicks.—A. **Sellerio**: The analysis of three galvanomagnetic effects. Confirmation of a new effect.—M. **Audant**: Contribution to the study of the critical state of ethyl ether. Studies on the variations of the critical temperatures with the tube-filling and on the critical opalescence.—M. **Pauthenier**: The ratio of the absolute retardations in the Kerr phenomenon for different wave-lengths in the case of nitrobenzene. Application of the method of instantaneous charges to carbon bisulphide. The ratio of the absolute retardations in both carbon bisulphide and nitrobenzene is −2 if the times of charge are sufficiently short.—E. **Damour**: The application value (*valeur d'usage*) of combustibles. This value is inversely proportional to the weights of two combustibles required to produce the same thermal effect in a given furnace. Since the efficiency depends on the nature of the fuel, the application value is not measured by the calorific value alone. The temperature of combustion is an important factor in determining the price of a fuel.—R. **Dubrisay**: The application of a new method of physico-chemical analysis to the study of double salts. The method is based on

the measurement of miscibility temperatures with phenol. The miscibility temperatures of certain pairs of salts follow very nearly an additive rule; other salts show marked deviations, and for these the existence of double salts in solution appears probable.—MM. **Lespieau** and **Bourguel**: The production of true acetylene hydrocarbons starting from epidibromhydrin. Compounds of the type $CH_2{:}CBr{\cdot}CH_2R$ are readily obtained by the interaction of α-epidibromhydrin and a magnesium alkyl derivative, and from these by three simple reactions good yields of substituted acetylenes, $HC{:}C{\cdot}CH_2R$, are produced. Full details of the preparation of normal pentine (*n*-propylacetylene) by this method are given.—E. **Chaput**: Remarks on the *rôle* of dislocations in the tectonic of the Côte d'Or.—P. **Bonnet**: The movements of the seas at the limit of the Permian and the Trias in the geosynclinals of Eurasia.—G. M. **Stanoievitch**: The aeroplane and hail. Suggestions for the prevention of hailstorms by aeroplanes.—M. **Nobécourt**: The anatomical structure of the tubercles of the Ophrydeæ.—G. **Mangenot**: The evolution of the chromatophores and the chondriome in the Florideæ.—P. **Guérin** and Ch. **Lormand**: The plasmolytic action of a certain number of vapours.—MM. **Lapicque** and **Brocq-Rousseu**: Marine algæ as food for the horse. An account of an experiment on two horses in full work. The oats in the ration were gradually replaced by seaweed (*Laminaria flexicaulis*), and the horses worked normally for twenty days on food from which oats were absent. Then the horses were put to extra heavy work for three days, still on hay and seaweed, and their condition was as good as that of horses doing the same work on the usual food, hay, straw, and oats.—M. **Gautier**: The influence of the attitude of the body on respiration.—A. **d'Arsonval**: Remarks on the preceding communication.—J. **Amar**: Attitudes of the body and respiration. Walking on the front of the foot, head thrown back, allows large and deep respirations. Walking on the heels has a contrary effect, generally harmful to the health.—R. **Wurmser**: The action of chlorophyll on radiations of different wave-lengths.—A. L. **Herrera**: The imitation of cells, tissues, cell-division, and the structure of protoplasm with calcium fluosilicate. Confirmation of the researches of MM. Gautier and Clausmann on the biological importance of fluorine. Calcium fluosilicate produced by the double decomposition of an alkaline silicate and potassium bifluoride in the presence of calcium chloride and water, if the diffusion of the solutions is very slow, gives remarkable imitations of the structure of protoplasm, natural cells, and their division. These imitations can be studied, stained, and preserved by the usual histological processes.—C. **Pérez**: A new type of Epicarid, *Rhopalione uromyzon*, sub-abdominal parasite of *Ostracotheres spondyli*.—J. **Dragoiu** and M. **Fauré-Fremiet**: Development of the aerial canals and the histogenesis of the pulmonary epithelium in the sheep.—W. R. **Thompson**: *Cyrillia angustifrons*, parasite of a terrestrial Isopod, *Metaponorthus pruinosus*.—P. **Thomas** and A. **Chabas**: The estimation of tyrosin and the dibasic amino-acids in the proteids of yeast.—A. **Mayer**, H. **Magne**, and L. **Plantefol**: The toxic action of dichloroethyl sulphide.—A. **Besredka**: An attempt at the purification of therapeutic sera.—F. **Ladreyt**: Histological polymorphism of certain epithelial neoplasms and the relations between these inflammatory neoformations to cancerous tumours.

SYDNEY.

Linnean Society of New South Wales, April 28.—Mr. J. J. Fletcher, president, in the chair.—G. H. **Hardy**: Synonyms, notes, and descriptions of Australian flies of the family Asilidæ. As a result of work done since the revision of Australian species of this family by Miss Ricardo in 1912–13, it has become possible to establish the identity of many of the species which were not identified at the time. The present paper deals almost entirely with the genus Neiotamus. Of the forty-seven species usually placed in sub-genera of this genus, twenty are dealt with and placed under twelve species; two additional species are described as new.—F. **Muir**: A new genus of Australian Delphacidæ (Homoptera). Most, if not all, of the described Australian Delphacidæ are from eastern States. Of the fourteen genera recorded as Australian the author considers only one as entogenic. The genus described as new in this paper is from King George's Sound, South-West Australia, and is regarded as entogenic.—Dr. C. P. **Alexander**: An undescribed species of Clytocosmus, Skuse (Tipulidæ, Diptera). The genus Clytocosmus was proposed by Skuse in 1890, and has remained monotypic until now, the type species being *C. Helmsi* from Kosciusko. A second species is here described as new from Ulong, on the Dorrigo tableland.

Books Received.

A Text-Book of Organic Chemistry. By E. de B. Barnett. Pp. xii+380. (London: J. and A. Churchill.) 15*s*. net.

Johnston's New Era School Atlas. Pp. 40. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 1*s*. net.

Orographical, Regional, Economic Atlas. Part i.: British Isles. Pp. 32. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 1*s*. 6*d*. net.

Notes on Dynamics: With Examples and Experimental Work. By T. Thomas. Pp. 123. (London: Crosby Lockwood and Son.) 6*s*. net.

The Nomenclature of Petrology. By Dr. A. Holmes. Pp. v+284. (London: T. Murby and Co.) 12*s*. 6*d*. net.

The Botany of Iceland. Edited by Dr. L. K. Rosenvinge and Dr. E. Warming. Vol. ii., part 1. Pp. 248+5 plates. (Copenhagen: J. Frimodt; London: J. Wheldon and Co.)

The Life and Work of Sir Jagadis C. Bose (an Indian Pioneer of Science). By Prof. P. Geddes. Pp. xii+259. (London: Longmans, Green, and Co.) 16*s*. net.

Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri. Bind 5, No. 9, 1919. Investigations as to the Effect of the Restriction on Fishing during the War on the Plaice of the Eastern North Sea. By Dr. A. C. Johansen and Dr. K. Smith. Pp. 53. Serie Fiskeri. Bind 6, No. 1, 1920. On the Occurrence of the Post-larval Stages of the Herring and the "Lodde" (*Clupea harengus*, L., and *Mallotus villosus*, O. F. M.) at Iceland and the Faeroes. By P. Jespersen. Pp. 24. (København: C. A. Reitzel.)

Fisheries. England and Wales. Ministry of Agriculture and Fisheries. Fishery Investigations. Series ii.: Sea Fisheries. Vol. iv., No. 3. Report on the Scales of some Teleostean Fish, with special reference to their Method of Growth. By G. W. Paget. Pp. 24+4 plates. 3*s*. 6*d*. net. Series iii.: Hydrography. Vol. i.: The English Channel. Part 3: The Section from the Isle of Wight to Havre. Review of the Physical and Chemical Properties of the Surface Waters, and the Variations of these Properties from August, 1904, to December, 1918, in Comparison with Corresponding Variations on the Sections discussed in parts 1 and 2 of this volume.

By Dr. E. C. Jee. Pp. 24. 3s. net. Series iii.: Hydrography. Vol. i.: The English Channel. Part 4: The Section from Newhaven to Caen. Review of the Physical and Chemical Properties of the Surface Waters, and the Variations of these Properties from November, 1903, to May, 1912, in the English Channel from Newhaven to the Bay of the Seine. By Dr. E. C. Jee. Pp. 26. 3s. net. Series iii.: Hydrography. Vol. iv.: The North Sea. Part 1: From the River Tyne towards the Naze of Norway. Review of the Variations of the Physical and Chemical Properties of the Waters of the North Sea, together with Observations on the Dogger Bank. By Dr. E. C. Jee. Pp. 101. 12s. net. (London: H.M. Stationery Office.)

On Gravitation and Relativity: Being the Halley Lecture delivered on June 12, 1920. By Dr. R. A. Sampson. Pp. 24. (Oxford: At the Clarendon Press.) 2s. net.

Caithness and Sutherland. By H. F. Campbell. Pp. ix+168. (Cambridge: At the University Press.) 4s. 6d. net.

Kirkcudbrightshire and Wigtownshire. By W. Learmonth. Pp. ix+149. (Cambridge: At the University Press.) 4s. 6d. net.

Creation: Viewed by the Light of Modern Science. A Lecture given by W. Hackney, 1875. Pp. vi+29. (London: N. G. Hackney.)

Heredity and Social Fitness: A Study of Differential Mating in a Pennsylvania Family. By Dr. W. E. Key. Pp. 102. (Washington: Carnegie Institution.)

The Inscriptions at Copan. By S. G. Morley. Pp. xii+643+33 plates. (Washington: Carnegie Institution.)

Department of Agriculture and Natural Resources, Weather Bureau. Annual Report of the Weather Bureau for the Year 1917. Part 3: Meteorological Observations made at the Secondary Stations during the Calendar Year 1917. Pp. 360. (Manila.)

Union of South Africa. Department of Mines and Industries. Geological Survey. Memoir No. 13: Mica in the Eastern Transvaal. By A. L. Hall. Pp. 95+xviii plates. (Johannesburg.) 7s. 6d.

Type Ammonites. By S. S. Buckman. Part xxii. Pp. 17–18+16 plates. (London: W. Wesley and Son.)

Unconscious Memory. By S. Butler. Third edition. Pp. xxxix+186. (London: A. C. Fifield.) 8s. 6d. net.

Luck, or Cunning, as the Main Means of Organic Modification? An Attempt to Throw Additional Light upon Darwin's Theory of Natural Selection. By S. Butler. Second edition. Pp. 282. (London: A. C. Fifield.) 8s. 6d. net.

The Assessment of Physical Fitness by Correlation of Vital Capacity and Certain Measurements of the Body. By Prof. G. Dreyer, in collaboration with G. F. Hanson. Pp. xi+115. (London: Cassell and Co., Ltd.) 10s. net.

A Geographical Bibliography of British Ornithology from the Earliest Times to the End of 1918. By W. H. Mullens, H. Kirke Swann, and Rev. F. C. R. Jourdain. Part v. Pp. 385–480. (London: Witherby and Co.) 6s. net.

Department of the Interior. Bureau of Education. Statistics of State School Systems, 1917–18. By H. R. Bonner. Pp. 155. (Bulletin No. 11, 1920.) (Washington: Government Printing Office.)

The Tides and Tidal Streams. By Dr. W. B. Dawson. Pp. 43+viii plates. (Ottawa: Department of the Naval Service.)

Cocoa and Chocolate: Their History from Plantation to Consumer. By A. W. Knapp. Pp. xii+210. (London: Chapman and Hall, Ltd.) 12s. 6d. net.

The Extra Pharmacopœia of Martindale and Westcott. Revised by Dr. W. H. Martindale and Dr. W. W. Westcott. Seventeenth edition. In 2 vols. Vol. i. Pp. xxxix+1115. (London: H. K. Lewis and Co., Ltd.) 27s. net.

British Museum (Natural History). Economic Series, No. 1. The House-fly as a Danger to Health. By Major E. E. Austen. Pp. 20. 3d. Economic Series, No. 3. Fleas as a Menace to Man and Domestic Animals. By J. Waterston. Pp. 20. 4d. Economic Series, No. 4. Mosquitoes and their Relation to Disease. By F. W. Edwards. Second edition. Pp. 19. 4d. Economic Series, No. 6. Species of Arachnida and Myriopoda (Scorpions, Spiders, Mites, Ticks, and Centipedes) Injurious to Man. By S. Hirst. Second edition. Pp. 59+3 plates. 1s. Economic Series, No. 8. Rats and Mice as Enemies of Mankind. By M. A. C. Hinton. Second edition. Pp. x+67+2 plates. 1s. (London: British Museum (Natural History).)

Diary of Societies.

THURSDAY, JULY 15.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

CHADWICK PUBLIC LECTURE (in Surveyors' Institution), at 5.15.—Dr. N. White: Health Conditions in Eastern Europe—Typhus a Serious Menace.

RÖNTGEN SOCIETY (at University College), at 9.—Dr. W. D. Coolidge: Address (Special Open Meeting).

CONTENTS.

	PAGE
Medical Research. By Prof. G. Elliot Smith, F.R.S.	605
Intellectual Stock-taking. By H. W. C.	607
Petroleum Geology. By H. B. Milner	608
Fuel Problems. By J. S. S. B.	609
Hurter and Driffield. By C. J.	609
Our Bookshelf	610
Letters to the Editor:—	
The Separation of the Isotopes of Chlorine.—D. L. Chapman, F.R.S.	611
Anti-Gas Fans.—Hertha Ayrton; Prof. A. Allmand	612
The Stretching of Rubber in Free Balloons.—Dr. Henry P. Stevens; W. H. Dines, F.R.S.	613
Notes on the Habits of the Tachinid Fly, *Sphexapata* (*Miltogramma*) *conica*.—Oswald H. Latter	614
Temperature Variations at 10,000 ft.—C. K. M. Douglas	614
The Brent Valley Bird Sanctuary.—Wilfred Mark Webb	614
Researches on Growth of Plants. I. (*Illustrated.*) By Sir Jagadis Chunder Bose, F.R.S.	615
Isotopes and Atomic Weights. (*Illustrated.*) By Dr. F. W. Aston	617
Obituary:—	
Major-Gen. William Crawford Gorgas, K.C.M.G.	620
Notes	622
Our Astronomical Column:—	
An Easy Method of Finding Latitude	625
Increasing the Photographic Power of Telescopes	625
A New Spectropyrheliometer and Solar Measurements made with it	625
British Association: Subjects for Discussion at the Cardiff Meeting	626
Museums Association Annual Conference	626
The University of Edinburgh: New Science Buildings	627
Lessons from the Smithsonian	627
The Religion and Origin of the Hawaian People. By Sidney H. Ray	628
Soil Temperatures. By B. A. K.	628
Control of Insect Pests	629
Scientific and Systematic Pomology	629
University and Educational Intelligence	630
Societies and Academies	631
Books Received	635
Diary of Societies	636